Principles of Manufacturing

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5922
Co-requisite(s):	*Algebra I* (0842, 3102)*, Geometry* (0843, 3108)*, Physical Science* (3202) (recommended)
Credit:	1 credit for core and two focus areas. 2 credits for all 35 standards.
Grade Level:	9
Graduation Requirement:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the first course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 707, 760
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved January 30, 2015; Amended April 15, 2016

Course Description

Principles of Manufacturing is designed to provide students with exposure to various occupations and pathways in the Advanced Manufacturing career cluster, such as Machining Technology, Electromechanical Technology, Mechatronics, and Welding. In order to gain a holistic view of the advanced manufacturing industry, students will complete all core standards, as well as standards in two focus areas. Throughout the course, they will develop an understanding of the general steps involved in the manufacturing process and master the essential skills to be an effective team member in a manufacturing production setting. Course content covers basic quality principles and processes, blueprints and schematics, and systems. Upon completion of this course, proficient students will advance from this course with a nuanced understanding of how manufacturing combines design and engineering, materials science, process technology, and quality. Upon completion of the *Principles of Manufacturing* course, students will be prepared to make an informed decision regarding which Advanced Manufacturing program of study to pursue. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

The following implementation options are encouraged:
- 1 credit for Core and two focus areas (listed below)
- 2 credits for all 35 standards.

Core standards are required for both one and two credit implementation options.
Core standards: 1-22, 35

Focus Areas	Standards
Machining Technology	23, 24, 25
Mechatronics	26, 27, 28
Electromechanical Technology	29, 30, 31
Welding	32, 33, 34

Program of Study Application

This is the first course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials, (4) ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. (TN Reading 3, 4)

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment. (TN Reading 3, 4)

Overview of Manufacturing

3) Define manufacturing and describe how it is used to solve problems. Research the five general steps of manufacturing (preparation, processing, assembly, finishing, and packaging). Select a product and trace its development through each of the five steps. For example, deliver a presentation explaining how a smart phone goes from raw materials to final packaged product. (TN Reading 2, 4; TN Writing 2, 4, 7, 8, 9)

4) Distinguish between primary and secondary processes involved in the manufacture of industrial goods into finished products. Summarize in a graphic illustration or narrative how different processes make use of specific manufacturing applications, such as the use of welding in assembling processes. Relate the specific operations required to implement the following secondary processes:

   a. Casting and molding (e.g., sand casting)
   b. Forming (e.g., metal forming)
   c. Separating (e.g., machining)
   d. Assembling (e.g., welding)
   e. Direct digital and additive manufacturing (e.g., 3-D printing)
   f. Finishing (e.g., electroplating)
   (TN Reading 4, 9; TN Writing 4)

5) Research the history of manufacturing. Summarize its evolution from the Industrial Age to the rise of mechanization and automation in the manufacturing industry. Create a timeline or infographic that identifies milestones in the industry that led to today's advanced manufacturing environments. For example, discuss both the history of the assembly line and the use of robots, describing how they transformed the manufacturing industry. (TN Reading 1; TN Writing 4, 7)

6) Explain that manufacturing is a technological system that transforms raw materials into products in a central location (e.g., a factory). Technological systems include the following elements: inputs, processes, outputs, feedback, and goals. As a team, select a manufacturing system, such as metal fabrication, and use diagrams and other multimedia to demonstrate its operation. Identify each element and explain its role in the system. (TN Reading 1, 4, 7; TN Writing 4)

7) Explore the onset of advanced manufacturing and explain how it applies information, automation, computation, software, sensing, and networking to make traditional processes more efficient. Describe how advanced manufacturing incorporates the use of modern materials and recent discoveries in physical and biological sciences. For example, report on the use of nanotechnology. (TN Reading 1, 2, 4)

Materials

8) Identify and describe a wide range of materials used in manufacturing: organic, inorganic, engineering (metallic, polymeric, ceramic, composite), and non-engineering (gases and liquids). Distinguish between the materials and provide examples of how they are converted into products. (TN Reading 1, 4)

9) In teams, research the major material properties: physical, mechanical, chemical, thermal, electrical/magnetic, acoustical, and optical. Considering the use of materials in the various areas of advanced manufacturing (e.g., welding, machining, mechatronics, and electromechanical technology), discuss the following:
   a. Characteristics that make up the physical properties of a material
   b. How the mechanical properties affect the way a material will react to forces or loads
   c. How natural elements react with a material and affect its performance
   d. Characteristics that make up thermal properties of a material (e.g., thermal resistance, thermal expansion, thermal emission, thermal shock resistance)
   e. Three major groups of materials that carry an electrical current (e.g., conductors, semiconductors, resistors)
   f. Two major properties that describe how a material reacts to sound waves (e.g., acoustical transmission, acoustical reflection)
   g. Three general optical properties (e.g., color, light transmission, light reflection).
   Explain why these properties are important to the selection and application of materials in a production setting. (TN Reading 1, 2, 4, 5, 6)

Career Exploration

10) In teams, use an online editing tool to develop an informational paper or infographic illustrating various career opportunities and pathways in the advanced manufacturing industry (welding, mechatronics, machining technology, and electromechanical technology). The descriptions should contain definitions, job roles, professional societies, and applicable licenses and/or certifications associated with each career. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. (TN Reading 1, 7, 8; TN Writing 2, 6, 8, 9)

11) Research the postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer programs leading to careers in advanced manufacturing. Write an informative paper or develop an infographic identifying admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare individuals to be successful in a postsecondary program. (TN Reading 1, 5; TN Writing 4)

Layout and Measurement

12) Identify and demonstrate proper use of the following typical measuring tools. Determine when it is appropriate to use linear distance, diameter, and angle measuring tools, and record accurate and repeatable measurements, attending to appropriate units and quantities.
   a. Tape rule
   b. Machinist's rule
   c. Bench rule

d. Caliper
e. Divider
f. Depth gage
g. Micrometer
h. Square
i. Protractor
j. Combination set

(TN Reading 1, 3, 4, 7; TN Writing 4; TN Math N-Q, G-GMD)

13) Explain why proper layout is critical to making parts properly. Select a typical part and correctly demonstrate the following steps, or use a similar multistep procedure, to lay out the shape of a part.
   a. Measure off the part size on standard stock.
   b. Cut the part blank out of the standard stock.
   c. Draw center lines for holes and arcs.
   d. Locate holes and arcs.
   e. Mark centers of holes.
   f. Draw tangent lines.
   g. Layout straight cuts.

(TN Reading 3, 4, 5, 7; TN Writing 4; TN Math N-Q, G-GMD)

Blueprint Reading and Interpretation

14) Define the differences in technique among freehand sketching, manual drafting, and computer-aided drafting (CAD), and describe the skills required for each. Create a two-dimensional orthographic (multiview) drawing incorporating labels, notes, and dimensions, using sketching/geometric construction techniques. Apply basic dimensioning rules and properly use different types of lines (e.g., object, hidden, center). The orthographic projections should include principle views of a simple object from top, front, and right sides. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

15) Compare and contrast the following types of engineering drawings. Describe the characteristics and explain the different applications of each drawing type. Identify and distinguish between symbols that are unique to the different pathways in advanced manufacturing (e.g., machining technology, electromechanical technology, mechatronics, and welding). For example, electromechanical technology often uses schematic symbols for common electrical components and machining technology often uses symbols for surface finishes.
   a. Detail drawings
   b. Assembly drawings
   c. Systems drawings

(TN Reading 4, 9)

16) Inspect and interpret blueprints, schematic diagrams, or written specifications for manufacturing devices and systems. Explain how the pictorial representations relate to an actual project layout, verifying sufficient agreement as prescribed by specified tolerances. For example, use a hydraulic schematic to show how fluid travels through a hydraulic circuit in an actual system. (TN Reading 1, 5; TN Writing 7; TN Math N-Q, G-CO, G-GMD)

Sequencing of Manufacturing Operations

17) In teams, investigate the role of a manufacturing engineer in designing efficient manufacturing systems. Create samples of the following documents which engineers often use to ensure that manufacturing operations are completed in a logical and efficient order. Use the sample documents to manage the completion of short projects and assignments in this course. Documents include the following:
   a. Operation sheet
   b. Flow process chart
   c. Operations process chart
   (TN Reading 1, 3, 7; TN Writing 4)

Quality Assurance and Continuous Improvement

18) In teams, research the three basic types of data that are important to controlling the manufacturing of a product: product output data, quality control data, and labor data. Describe and explain each type, including sample illustrations of the various reports needed by analysts (e.g., production report, material rejection form, inspection report). Provide examples of how a process can be improved depending on the outcome of each data type. (TN Reading 1, 4, 7)

19) Examine common statistical processes to analyze data. As a class, develop standard procedures for analysis to apply to manufacturing projects throughout the course and program of study. The procedures should include:
   a) Collection of data
   b) Analysis methods
   c) Interpretation of results
   (TN Reading 1, 3, 4, 7; TN Writing 2, 4)

20) Define the concept of quality control in the manufacturing industry. Summarize the roles of various personnel involved in ensuring quality control over production, including those who make the products, those who design the processes, and those who inspect the finished products. Describe why quality control is important to manufacturing processes, including how it affects customers, retailers, and manufacturers. Provide examples of how quality control could be applied to various manufacturing practices like electromechanical technology, machining technology, mechatronics, and welding. (TN Reading 1, 2, 4)

21) As a class, research quality improvement tools and strategies such as the Plan-Do-Check-Act cycle, and collaboratively create quality control guidelines and reports to reference as products are fabricated and assembled throughout the semester and program of study. Include plans for corrective action to address common quality problems. (TN Reading 1, 3, 4; TN Writing 2, 4)

22) Investigate the functions of process management in a manufacturing workplace: planning, organizing, directing, and controlling. Explain each function and describe the relationship between process management and quality assurance. For example, compare and contrast the costs of preventive maintenance, safety practices, and quality control with the costs of equipment repair, workplace accidents, and inefficient processes. (TN Reading 1, 3, 4, 9)

Machining Technology

23) Demonstrate proper application of common machine shop hand tools. Identify the following tools and provide examples of how they should be used safely.
   a. Clamping devices
   b. Pliers
   c. Wrenches
   d. Screwdrivers
   e. Chisels
   f. Hacksaws
   g. Reamers
   h. Hand taps
   i. Dies

   Given a specific machining assignment, select two or more of the above hand tools for the task. Explain why the tools were selected to complete the assignment. (TN Reading 1, 3, 4; TN Math N-Q, G-GMD)

24) Identify and explain the equipment, equipment setup, and techniques that apply to the following operations:
   a. Sawing
   b. Drilling
   c. Grinding
   d. Milling

   Given a specific machining assignment, comply with safe and efficient work practices and perform basic operations using both manual and machine-guided techniques. Properly set controls and speeds of the machines; remove and replace parts; and visually examine machined surfaces for meeting the given specifications. (TN Reading 1, 3, 4; TN Math N-Q, G-GMD)

25) Research the development of numerical control machines, including how computer numerical control (CNC) technology evolved. Compare and contrast CNC machines with manually controlled machines and identify the chief benefits associated with them. Demonstrate operation of a CNC machine to perform basic tasks. (TN Reading 1, 3, 4; TN Math N-Q, G-GMD)

Mechatronics

26) In teams, research the history of mechatronics and summarize how it evolved into modern-day applications. Using the research findings, create an infographic or presentation that can be used to (a) explain the mechatronics field, (b) why it is critical to the advanced manufacturing industry, (c) the skills needed to be successful in this field, and (d) why there is a demand for mechatronics professionals. (TN Reading 1, 4, 7; TN Writing 2, 4, 7, 8)

27) Identify and describe the following components of a typical mechatronic system. Select a common machine, such as a robot or a copy machine, to illustrate an example of a mechatronic system. Using supporting evidence from the machine and/or its accompanying schematic, explain why the machine is considered a mechatronic system.

   a. Actuators
   b. Sensors

     c. Digital control devices
     d. Input devices
     e. Output devices
     f. Graphical displays
(TN Reading 1, 2, 4, 7, 9)

28) Log, store, and export data received from two or more sensors (e.g., vision/light, audio, and touch) in a robotic or automated system. Explain why these procedures would be useful in a manufacturing process and provide specific examples. (TN Reading 3, 4; TN Writing 4)

Electromechanical Technology

29) Explain how belt drives and chain drives are used to transmit power in an electromechanical system. Compare and contrast the two drive types and describe the advantages and disadvantages of using each. Make a claim about the appropriate drive type for a given situation, citing data and evidence to support claim and address counterclaims. (TN Reading 1, 2, 9; TN Writing 1)

30) Identify and define the following common electrical quantities, including the unit of measurement and symbol (abbreviation) for each unit.
     a. Current
     b. Voltage
     c. Resistance
     d. Conductance
     e. Power
     f. Charge
(TN Reading 1, 2, 7)

31) Compare and contrast the two types of fluid power systems (pneumatic and hydraulic). Describe and explain the components they have in common; then identify the characteristics that render certain advantages to using one system over the other. For example, heavy construction machinery often uses hydraulic systems because they have the ability to support heavy loads. (TN Reading 1, 2, 9)

Welding

32) Interpret welding-specific drawings and welding symbol information. Differentiating between drawings and blueprints, examine parts to determine the application of symbols from drawings, sketches, and blueprints. (TN Reading 1, 4, 7)

33) Examine given shop and assembly drawings for a weldment composed of five to ten components. Interpret the dimensions and write a plan describing the materials and tools needed to complete the assignment. Make the required cuts and execute the plan. (TN Reading 1, 3, 4, 7; TN Writing 2; TN Math N-Q, G-GMD)

34) Identify and explain the equipment, equipment setup, and techniques that apply to the following thermal cutting operations:
     a. Oxyfuel cutting

b. Plasma-arc cutting
    c. Air carbon arc cutting
    d. Sawing
    e. Shearing
    f. Punching

Perform straight, shaped, and beveled cutting operations using both manual and machine-guided techniques. Properly use weld-washing techniques and visually examine cut surfaces for meeting the given specifications. (TN 1, 3, 4, 7; TN Writing 4; TN Math N-Q, G-GMD)

Latest Trends in Advanced Manufacturing

35) Explore a range of new and emerging trends in advanced manufacturing. A trend could be the change in the types of skills needed in manufacturing, the use of computers, or the use of advanced materials in recent years. Examples include the following:
    a. Sensing, measurement, and process control
    b. Materials design, synthesis, and processing
    c. Digital manufacturing technologies
    d. Sustainable manufacturing
    e. Nanomanufacturing
    f. Flexible electronics manufacturing
    g. Biomanufacturing
    h. Additive manufacturing
    i. Industrial robotics
    j. Advanced forming and joining technologies

Research one or more of these trends in depth, and compile, review, and revise a presentation or a paper explaining both the technical aspects involved (i.e., what skills are needed) and the effects on businesses, workers, and society. (TN Reading 1, 4, 7; TN Writing 2, 5, 8)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Geometry.

- o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Machining I

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5929
Pre-requisite(s):	*Algebra I* (0842, 3102)*, Principles of Manufacturing* (5922) Recommended: *Geometry* (0843, 3108), *Physical Science* (3202)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the second course in the *Machining Technology* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760
Required Teacher Certifications/Training:	Some endorsements require NIMS industry certification to teach this course. Please refer to the correlation of course codes for a full list.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved January 30, 2015; April 15, 2016

Course Description

Principles of Machining I is designed to provide students with the skills and knowledge to be effective in production environments as a machinist, CNC operator, or supervisor. Upon completion of this course, proficient students will demonstrate safety practices concerning machining technology, proper measurement and layout techniques, reading and interpreting drawings and blueprints, production design processes, and quality control procedures. Upon completion of this course, students will be knowledgeable about potential postsecondary education and career opportunities related to machining technology and will be prepared to enroll in more advanced machining courses in high school. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Machining Technology* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE) as recommended by Occupational, Safety & Health Administration (OSHA) regulations, American Society for Testing Materials, ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Incorporate safety procedures and complete the safety test with 100 percent accuracy. ~~(TN Reading 1, 2, 3, 4)~~

2) Adhering to proper safety guidelines, develop a schedule and create documents for a checklist to perform daily, weekly, and/or monthly routine maintenance on hand tools, conventional machines, and computer numerical control (CNC) machine tools. The checklist should also include, but is not limited to, cleaning the work area and appropriately handling and disposing of environmentally hazardous materials. ~~(TN Reading 3; TN Writing 4)~~

Overview of Machining Technology

3) In teams, research the evolution of machining technology, and describe how it has affected the workforce and the manufacturing industry in particular. Report on early machining tools, how power sources changed, basic machine tool operation, non-traditional machining processes, and automated machining processes. Cite evidence to support the information presented. ~~(TN Reading 1, 4; TN Writing 2, 4, 7, 8, 9)~~

Career Exploration

4) Investigate how the role of a machinist has changed with the evolution of machining technology.

Describe the various machining job categories and their characteristics. Research a range of postsecondary institutions (e.g., colleges of applied technology, community colleges, and four-year universities) and professional organizations (National Institute for Metalworking Skills [NIMS]) to identify the skills, education, and training requirements to become a machinist. (TN Reading 1, 4, 9; TN Writing 2, 4)

Measurement and Layout

5) Given a specific machining task, select the appropriate tool and accurately measure solid shapes or simple parts. Record the measurements in both English and metric units using the correct number of significant figures. Perform basic mathematical calculations and/or calibrations using tools such as the following:
   a. Micrometers
   b. Verniers
   c. Gages
   d. Dial indicators
   e. Helper measuring tools (e.g., calipers, telescoping gage, small hole gage)
   (TN Reading 3; TN Writing 4; TN Math G-GMD)

6) Calculate the speeds, feeds, and depth of cut for various machines and determine the tools needed for machining a simple part. Correctly interpret recorded measurements and use them to set up or adapt a process. (TN Reading 1, 3; TN Writing 4; TN Math N-Q)

7) Identify and explain the proper use of the following common layout tools used in machining technology. Given a specific machining task, use a multistep layout procedure to locate and mark lines, circles, arcs, and points for drilling holes and making cuts. Such as:
   a. Lines: layout dye, scriber, divider, surface plate, v-blocks, straightedge, squares
   b. Angles: plain protractor, vernier protractor
   (TN Reading 1, 3, 5, 6; TN Writing 4; TN Math N-Q, G-GMD)

Blueprint Reading and Interpretation

8) Demonstrate technical literacy in the symbols, lines, and figures devised by the American National Standards Institute (ANSI). Distinguish between the past and present metalworking symbols (e.g., counterbore, countersink, and drill) and explain why it is important to be familiar with both. (TN Reading 1, 4, 7, 8)

9) Classify and compare the different types of dimensions on drawings needed to produce a part or an object. Read and interpret drawings that are dimensioned in fractional inches, decimal inches, and in metric units. For example, drawings dimensioned in decimal parts of a unit indicate greater precision. (TN Reading 1, 4, 7; TN Math N-Q)

10) Examine and interpret drawings to manufacture an object. Report and define information necessary to complete a machining task, such as the materials to be used, required surface finish, tolerances, quantity of units, scale, assembly and subassembly instructions, past revisions, and the name of the object. Explain the interpretation of drawings and provide supporting evidence. (TN Reading 1, 4, 7; TN Math N-Q)

11) Given a set of machining drawings, distinguish between the detail and the assembly drawings. Compare and contrast the characteristics and applications of each. Describe a multistep procedure to use the drawings in order to complete a series of tasks related to a given assignment. For example, use the scale of a drawing to determine dimensions not explicitly shown on the drawing. (TN Reading 1, 3, 9)

Materials

12) Using the following classifications, explain how metals are classified, identify general characteristics of each type, and describe related safety precautions that should be applied during machining procedures.
    a. Ferrous metals
    b. Nonferrous metals
    c. High-temperature metals
    d. Rare metals
    (TN Reading 1, 3, 4, 9)

13) Investigate the chemical and physical properties of materials used in the machining process. Considering the following common materials, list the principle properties relevant to machining tasks.
    a. Carbon steels
    b. Stainless steels
    c. Structural steels
    d. Cast iron
    e. Aluminum
    (TN Reading 1, 4; TN Writing 4)

Production Design Process to Machine Parts

14) Given a team assignment, formulate strategies to manufacture a simple part. The strategies should include designing a flow process that organizes equipment and materials needed for cutting, drilling, milling, grinding, and/or other machining operations. Also, organize a plan for layout, setup, and performance of tapping, countersinking, counterboring, and reaming as needed. Implement the above strategies to manufacture the part. (TN Reading 1, 3, 4; TN Writing 4; TN Math N-Q)

15) Simulate the work of a machining team to develop and manufacture a product idea, accounting for given specifications and potential constraints. Prior to manufacturing the product, use the following multistep process to outline a plan demonstrating how the product will be manufactured efficiently. The plan should include justification for the number of parts needed, how the parts were standardized, and the ability to process the parts.
    a. Develop initial designs
    b. Refine designs
    c. Create a conceptual model and prototype
    d. Present design ideas
    e. Obtain management approval for design
    f. Manufacture the final product
    (TN Reading 1, 3; TN Writing 1, 4, 6, 7)

Quality Control

16) Measure, weigh, and visually inspect machined parts. Record and compare data to given project specifications using class-defined analysis methods. Interpret and communicate results both written and verbally. If necessary, recommend changes that will reduce the number of product defects during the manufacturing process. (TN Reading 1, 3, 4, 7; TN Writing 1, 4; TN Math N-Q, G-GMD)

17) Drawing upon multiple resources, research both destructive and nondestructive testing used as quality control techniques to prevent manufacturing defects in machining technology. Explain the importance of accurate measuring tools that are calibrated by the National Institute of Standards Technology (NIST) guidelines. In addition, explore other testing techniques such as the use of coordinate measuring machines (CMM), use of optical comparators, radiographic inspection, magnetic particle inspection, ultrasonic inspection, and laser inspection. Compare and contrast these techniques and provide specific examples for when they are most appropriately used. Cite evidence to justify the examples. (TN Reading 1, 3, 9; TN Writing 1, 4, 5, 8)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Machining II

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5923
Prerequisite(s):	*Algebra I* (0842, 3102), *Geometry* (0843, 3108), *Physical Science* (3202), and *Principles of Machining I* (5929). Recommended co-requisite: *Physics* (3231)
Credit:	2
Grade Level:	11
Graduation Requirement:	This course satisfies two of three credits required for an elective focus when taken in conjunction with other Manufacturing courses.
Programs of Study and Sequence:	This is the third course in the *Machining Technology* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com/ Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760
Required Teacher Certifications/Training:	Some endorsements require NIMS industry certification to teach this course. Please refer to the correlation of course codes for a full list.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved April 10, 2015; April 15, 2016

Course Description

Principles of Machining II is an advanced level contextual course that builds on the introductory skills learned in the entry-level manufacturing and machining courses, stressing the concepts and practices in a production environment supported by advanced machining and engineering facilities. Working with the course instructor and team members in a cooperative learning environment, students will design, produce, and maintain products that are defined by detailed technical specifications. Emphasis is placed on quality control, safety and engineering codes and standards, and production-grade machining systems, building on the learner's past knowledge, current experiences, and future conduct as a career machinist. Upon completion of this course, proficient students will be able to examine blueprints and specification drawings to plan and implement the manufacture of products, machine parts to specifications using both manual and computer-controlled machine tools, and measure, examine, and test completed products to check for defects and conformance to specifications. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the third course in the *Machining Technology* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Measurement and Mathematical Concepts for Machining

1) Determine the appropriate units and record accurate and repeatable measurements of length, diameter, and thickness to complete projects using:
   a. Rules, gages, calipers, and micrometers
   b. Tools equipped with dials, vernier scales, and digital readouts
   c. Both metric and English scales
   d. Appropriate standards of accuracy and precision
   e. Satisfactory tolerances permissible for a given task

   For example, while grinding a piece to a specified thickness, measurements with a metric vernier caliper are used to achieve a value within the tolerance specified by the drawing. ~~(TN Reading 3, 7; TN Math N-Q, G-GMD)~~

2) Determine the appropriate units and record accurate and repeatable measurements of angles to complete projects by:
   a. Applying principles of trigonometry, Cartesian geometry, and/or polar geometry, distinguishing when and which principles apply to a given machining task.
   b. Using angle gages, a plate protractor, a universal bevel protractor with vernier scale, square, and/or a sine bar and gage blocks or adjustable parallel.

   For example, measure the angle formed by two surfaces of a machined part to the nearest 0.01 degree using a sine bar. ~~(TN Reading 3, 7; TN Math N-Q, A-REI, F-TF, G-SRT)~~

3) Determine the appropriate units and record accurate and repeatable measurements of material properties such as hardness, pH, and load/elongation test curves of stress, strain, modulus, and yield. Interpret test values and curves, and use calculated results to make informed decisions.

For example, measure the Rockwell hardness of a piece of stainless steel to determine the recommended cutting speed with a carbide-tipped cutting tool. (TN Reading 3, 4; TN Math N-Q, A-SSE, A-CED, A-REI, G-MD)

Safety

4) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 1, 2, 3, 7; TN Math N-Q)

Design

5) Visualize and interpret engineering drawings for projects to
   a. Create an accurate bill of materials
   b. Identify and interpret geometric dimensioning and tolerancing symbols and nomenclature
   c. Identify primary and secondary datums

   For example, lay out correctly dimensioned bolt holes in a radial pattern specified by a drawing, and select proper tools to complete the required operations. (Reading 3, 4, 7; TN Writing 4; TN Math N-Q, G-CO, G-GMD, G-MG)

6) Anticipate the consequences and handling requirements of metals, alloys, ceramics, polymers, and composites to properly and safely handle and machine these materials. For example, research the material properties for the bill of materials for a project in preparation for choosing cutting tools, speeds, and handling. (TN Reading 1, 4, 5; TN Writing 4, 7; TN Math N-Q)

Operations & Control

7) Manage and coordinate the operation of the cutting pieces, feeds, and mounts associated with both manual and computer-numerical-controlled (CNC) machining tools to complete advanced projects involving:
   a. Milling machines, such as indexing operations using a dividing head and rotary tables
   b. Lathes, such as re-chase and internal threads, taper turning with taper attachments and compound rests, internal tapered surfaces, follower and steady rests
   c. Grinders, such as grinding pieces between centers, operating radius dressers, cylindrical grinders, and inside diameter (ID) grinders

   For example, select the correct cutting tools and speeds for the CNC processes to create Delrin (plastic) shafts and gears for a class robotics project. (TN Reading 3, 7; TN Math N-Q, G-C, G-GMD, G-MG)

8) Correctly, safely, and efficiently schedule, configure, administer, and verify heat-treatments to machined parts according to blueprint specifications. For example, while properly attired and

equipped, use an oven or torch to harden and temper a W1-grade steel bolt to yield a hardened, tamper-proof bolt. (Reading 3, 5, 7; TN Math N-Q, A-REI, G-MG)

Production & Processing

9) Solve manufacturing-related problems by analyzing and weighing the constraining factors including schedule, cost, materials, and equipment, as well as productivity, regulations, maintenance, and quality. For example, as part of an assigned machining project, draft, obtain approval, and implement a schedule for completion, including ordering materials, planning the sequence of machining and stepwise approvals, and determining a target for final delivery, justifying all recommendations with supporting evidence. (TN Reading 1, 5, 7; TN Writing 1, 4, 7; TN Math N-Q)

10) Employ statistical quality control test methods and techniques, especially on large volume processes, to minimize defects and waste due to poor quality. For example, use statistical sampling, measuring, and charting to monitor and detect the need for corrective action on a mass production of thread cutting. Upon completion of testing, draft a written report documenting the findings in the proper format that a quality control inspector would deliver to a supervisor or other superior. (TN Reading 3; TN Writing 2, 4, 6, 7; TN Math N-Q)

11) Explore and develop one's skills with new and emerging machining and manufacturing technologies, such as 3D printing, laser etching, computer-controlled machining, and digital manufacturing methods. For example, produce a small plastic part using a 3D printer, and then produce the same part with a CNC production method using G- and M-codes; compare the material cost and waste, manpower, scheduling, etc. of the two methods and provide written justification to persuade a prospective manufacturer, wholesaler, or other supplier why one method is more cost-effective, efficient, or profit-maximizing than the other. (TN Reading 3, 4, 7; TN Writing 1, 4; TN Math N-Q)

12) Demonstrate and practice teamwork, problem-solving, and decision-making skills required for success as a career machinist in a manufacturing environment. Applying the skills acquired in the previous standards, examine a given manufacturing problem to research and plan a solution that will result in the creation of a prototype for a manufactured product. This process will include but is not limited to the following:
   a. Reading and interpreting relevant engineering drawings
   b. Assessing prototyping processes
   c. Using engineering drawings as a planning tool for programming software to design the prototype
   d. Crafting appropriate documentation and justification of decisions made in the design process, for the purposes of explaining as well as persuading
   e. Creating a presentation for the design and construction of the manufactured product
   (TN Reading 3, 4, 7, 9; TN Writing 1, 2, 4, 7; TN Math N-Q)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 8, 9, and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Geometry.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Electromechanical

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6091
Prerequisite(s):	*Principles of Manufacturing* (5922), *Algebra I* (0842, 3102), and *Physical Science* (3202) Note: *Algebra I* and *Physical Science* may be taken as co-requisites.
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Manufacturing courses.
Programs of Study and Sequence:	This is the second course in the *Electromechanical Technology* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http:///www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 707, 760
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Introduction to Electromechanical is a foundational course that introduces students to basic electro-mechanical skills necessary in a manufacturing facility. Topics covered include safety, construction drawings, site layout, hand and power tools, linear and angular measurements, and application of

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algebraic and geometric principles to construction problems. Upon completion of this course, proficient students will be able to understanding, describe, and troubleshoot electromechanical systems. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Electromechanical Technology* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Manufacturing website a https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Assess a given situation requiring the use of tools, equipment, and materials. Explain the applicability of various safety standards and procedures, and then safely demonstrate the use of the tools, equipment, and materials. For example, the hoisting of material requires lifting equipment of sufficient strength and applicability to the task, physical clearance from personnel, necessary alerting to others, and authorization to use the required equipment, as well as conformance to Occupational Safety and Health Administration (OSHA) policies for avoiding and reporting accidents associated with this type of activity. ~~(TN Reading 2, 3)~~

2) Assess a given situation requiring the use of hand and/or power tools. Select the proper tool and accessories, critique the readiness of the tool, use the tool to accomplish the desired task, and then return the tool and accessories to its proper storage. For example, creating a hole in aluminum requires the choice of the proper drill, drill bit, mounting hardware, lubricant, and safety procedures and precautions. The suitability of the drill bit is just one of many aspects that must be assessed and analyzed. ~~(TN Reading 3)~~

3) Analyze situations, create plans, and implement plans requiring the use of rigging to install and/or remove equipment and machinery. Perceive and critique the safety risks involved in the job. For example, contrast the implications of lifting and positioning heavy objects of small compact shape versus those of large rotational moment. ~~(TN Reading 3, 4; TN Writing 4)~~

4) Identify and evaluate situations that require electrical circuits and electromechanical principles. Develop and safely implement a plan to achieve the desired electromechanical objective. For example, recognize the power requirements for operating a 35 hp lathe, develop a wiring plan, and draft the details for a work order. ~~(TN Reading 4)~~

Problem Solving & Critical Thinking

5) Create linear and angular drawings to represent real-world physical scenarios in two and three dimensions. For example, based on physical requirements for a bracket, develop a plan, and create a drawing based on the required geometry for accurately fabricating the bracket, including precise linear and angular measures. ~~(TN Reading 7; TN Math: N-Q, A-CED, G-GMD, G-MG~~)

6) Apply mathematics concepts to solve electronics and manufacturing industry problems. For example, calculate the impact of the addition of random variables representing material dimensions that include several tolerances and dimensional allowances on the final combined work product. (TN Reading 4, 7; TN Math: N-Q, A-SSE, A-REI)

7) Create two- and three-dimensional scale drawings using accepted dimensioning rules and measurement systems. For example, as part of a project to fabricate a custom-shaped metal block, develop the complete drawings that specify the dimensional details for each step of the construction process. (TN Reading 3, 7; TN Math: A-REI, G-CO, G-C, G-GMD, G-MG)

8) Identify and demonstrate basic troubleshooting strategies appropriate for evaluating electronic circuits/systems and electromechanical devices. For example, in a relay-logic circuit with four display bulbs, develop and implement a troubleshooting strategy to remedy a bulb that fails to light. (TN Reading 3; TN Math N-Q, S-IC)

Computers & Electronics

9) Demonstrate understanding of the operation of electrical circuits and devices and relate it to the physical laws (such as Ohm's Law, Kirchhoff's Law, and power laws) that govern the behavior of electrical circuits and devices. Accurately apply these physical laws to solve problems. For example, calculate and support the consequence of the maximum volume of air that can be moved by an AC-powered 50 hp electric motor. (TN Reading 3, 4; TN Math N-Q, A-CED, A-REI, F-BF)

10) Explain the interrelationships among sources of current, voltage, resistance, and power in electric circuits, both theoretical (illustrated) and actual by designing a direct current (DC) circuit of resistors and LEDs, and predicting the likely current and power requirement. Discriminate among used resistors in a junk box, using the color codes to identify resistors of suitable value. (TN Reading 1, 5; TN Writing 4; TN Math N-Q, A-REI)

11) Assemble the required connections of electronic test equipment to properly test the operation of basic electronic circuit behavior and performance, using equipment such as a digital multimeter, oscilloscope, and resistance bridge. For example, design, assemble, and verify a passive analog filter able to block at least 6 dB of audio-level signals of frequency greater than 500 Hz. (TN Reading 3; TN Math N-Q)

Production & Processing

12) Investigate an assortment of occupations and manufacturing processes that rely on electromechanical principles and technologies, such as shipyard rigging, metalworking, agricultural mechanics, construction, and medical prosthetics. Write an informative text that summarizes the typical educational and certification requirements, working environments, and career opportunities for these occupations. (TN Reading 2; TN Writing 2)

13) Analyze and describe a variety of quality control constraints on manufacturing materials, parts, and processes that impact the suitability of a given electromechanical production process. Collect and interpret data that includes, but is not limited to, physical and electrochemical properties such as size, mass, hardness, pH, temperature, conductivity, rate, and so forth, and

synthesize the results to yield a clear, written documentation of the findings. For example, assist a quality assurance inspector who must carefully complete the steps of a standard inspection order to certify an incoming shipment of raw material by making several measurements and tests for conformance to specification. ~~(TN Reading 1, 5; TN Writing 7)~~

14) Inspect and interpret blueprints, schematic diagrams, or written specifications for electromechanical devices and systems. Explain how pictorial representations relate to an actual project layout, verifying sufficient agreement as prescribed by specified tolerances. For example, create a proposed parts list for wiring a room addition based on electrical construction drawings, conforming to generally accepted building codes. ~~(TN Reading 1, 5; TN Writing 7; TN Math N-Q, G-CO, G-GMD)~~

15) Given a malfunctioning electromechanical system, use resources such as blueprints, diagrams, and equipment manuals to troubleshoot the machinery. Develop and graphically illustrate at least three possible solutions to the problem. Select the optimal solution and justify the selection with evidence drawn from the resources listed above. ~~(TN Reading 1, 4; TN Writing 1, 4)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 8, 9, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, 8, 9, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, upon completion of this course, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advanced Electromechanical Technology

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6090
Pre-requisite(s):	*Algebra* (0842, 3102), *Geometry* (0843, 3108), *Physical Science* (3202)*,* and *Introduction to Electromechanical* (6091)
Credit:	2
Grade Level:	11
Graduation Requirement:	This course satisfies two of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the third course in the *Electromechanical Technology* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 707, 760
Required Teacher Certifications/Training:	None
Teacher Resources:	http://www.tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Advanced Electromechanical Technology is designed to provide students with the knowledge and skills to effectively perform basic industrial maintenance procedures in an advanced manufacturing facility. Students in this course develop proficiency in a vast array of electromechanical domains, including: fundamental safety practices in electromechanical technology, shielded metal arc welding (SMAW), basic metal inert gas (MIG) welding, electrical systems, AC and DC motors, calibrating instruments, drive systems, pipe fabrication, hydraulic systems, pumps, digital electronics, programmable logic controllers

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(PLC), and troubleshooting procedures. Upon completion of this course, proficient students will be prepared to pursue postsecondary electromechanical technology programs and entry-level industrial maintenance technology careers in the advanced manufacturing industry. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.~~***** *This course is recommended for 2 credits.*

Program of Study Application

This is the third course in the *Electromechanical Technology* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Advanced Manufacturing website at http://www.tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Assess a given situation requiring the use of tools, equipment, and materials. Explain the applicability of various safety standards and procedures, and then safely demonstrate the use of the tools, equipment, and materials. For example, the hoisting of material requires lifting equipment of sufficient strength and applicability to the task, physical clearance from personnel, necessary alerting to others, and authorization to use the required equipment, as well as conformance to Occupational Safety and Health Administration (OSHA) policies for avoiding and reporting accidents associated with this type of activity. ~~(TN Reading 3)~~

2) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) National Electrical Code (NEC), (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials; ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. ~~(TN Reading 3, 4, 5)~~

3) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment. ~~(TN Reading 4)~~

Welding and Machining Operations

4) Interpret and use a welding sketch or drawing to demonstrate the proper setup of a shield metal arc welder. Use the shielded metal arc welding (SMAW) process and make single-pass and groove welds in the following positions:
   a. Flat
   b. Horizontal
   c. Vertical
   d. Overhead
   ~~(TN Reading 3, 4; TN Math N-Q, G-GMD)~~

5) Examine a given set of specifications for welding operations and properly set up a metal inert gas (MIG) welder to demonstrate the following five basic weld joint designs. Distinguish

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between the weld joint designs and provide various scenarios of how they are best applied. For example, edge joints are usually welded on one side, whereas a butt joint can be welded on both sides.

    a. Lap joint
    b. Butt joint
    c. Corner joint
    d. Edge joint
    e. T-joint

~~(TN Reading 3, 4, 9; TN Math N-Q, G-GMD)~~

6) Demonstrate the proper use of various types of grinders, such as hand-held and pedestal bench. Compare and contrast the process to use each grinder when performing cutting, smoothing, and deburring operations on a piece of metal. For example, use a grinder to cut and bevel pipe and plate prior to welding. ~~(TN Reading 3, 4; TN Math N-Q, G-GMD)~~

7) Manage and coordinate the operation of the cutting pieces, feeds, and mounts associated with both manual and computer-numerical-controlled (CNC) machining tools to complete projects involving:

    a. Milling machines, such as indexing operations using a dividing head and rotary tables
    b. Lathes, such as re-chase and internal threads, taper turning with taper attachments and compound rests, internal tapered surfaces, follower and steady rests

For example, select the correct cutting tools and speeds for the CNC processes to create Delrin (plastic) shafts and gears for a class robotics project. ~~(TN Reading 3, 7; TN Math N-Q, G-C, G-GMD, G-MG)~~

Electrical Circuits

8) Identify the basic characteristics and distinguish between the operation of direct current (DC) and alternating current (AC) electricity. Explain how and why the different currents are used. Provide examples of devices that use AC and DC respectively. ~~(TN Reading 3, 4)~~

9) Demonstrate an understanding of Ohm's law, and apply it to solving given problems in electrical systems. Defend the solution using supporting evidence that explains the cause and effect relationship between Ohm's law and each of the following:

    a. Voltage
    b. Current
    c. Resistance
    d. Voltage drop

~~(TN Reading 1, 2, 4; TN Writing 1, 4; TN Math N-Q, A-REI)~~

10) Examine electrical circuits and components. Solve various series-parallel circuit structures, using appropriate instruments to measure watts, volts, Ohms, and amps. Explain the multistep procedure used to solve each problem and justify the calculations using Ohm's law. ~~(TN Reading 3, 4; TN Writing 1, 4; TN Math N-Q, A-REI)~~

11) Explain basic control wiring and wiring processes used in the electrical industry. Properly apply these processes by wiring and testing devices, control circuits, and systems. For example, wire

and test electrical switches and devices used in a typical electromechanical system. (TN Reading 3, 4; TN Math N-Q)

12) Explain electron flow as it relates to electricity by creating a diagram or model to illustrate electron and induction flow. Use the model to also explain the role of magnetism and electromagnetic induction in electrical systems, including a comparison of the following magnetism concepts to their electrical counterparts:
    a. Reluctance to resistance
    b. Field distance to voltage
    c. Magnetic force to current
    (TN Reading 3, 4; TN Writing 2, 4)

Conductor Termination and Splices

13) Research the National Electrical Code (NEC) and local code requirements for the splicing, terminating, and insulating of conductors. Citing information found in code, write an explanation describing how and when it is appropriate to use wire nuts, crimp-on wire lugs, or mechanical compression connectors for making connections. Also include special considerations for making splices and connections to aluminum, as well as insulation systems applicable to common splices and terminations. (TN Reading 1, 2, 3, 4, 9; TN Writing 2, 4, 7, 9)

14) Complete a simulation of wiring for residential service. Select the appropriate size of wire nuts and complete multiple installations. Demonstrate wire terminations and splices by using the proper crimp-on wire lugs and mechanical compression connectors. Explain and justify the selection of parts with supporting evidence from the research findings (resulting from the previous standard). (TN Reading 2, 3, 4; TN Math N-Q)

Fuses and Circuit Breakers

15) Explore the characteristics and uses of fuses and circuit breakers. Apply this information to develop and explain a procedure that could be used to select a specific choice of fuse or circuit-breaker for over-current protection. (TN Reading 2, 3, 4; TN Math N-Q)

16) Identify various examples of fuses and circuit breakers. Examine the markings printed on a fuse and identify the characteristics of a fuse needing replacement. Using physical observation and technical manuals, explain how to classify a circuit breaker by its voltage, current, and interrupting-capacity ratings. (TN Reading 2, 3, 4, 9)

17) Following the correct electrical code practices for residential service, demonstrate the procedures to install, wire, test, and operate fuses and breakers in both single- and three-phase circuits. Demonstrate effective grounding practices, including the connection of ground wires and installation of bonding straps. (TN Reading 2, 3, 4, 6; TN Math N-Q)

Schematic Interpretation

18) Review a basic process instrument diagram (PID) and a basic electrical elementary print. Interpret the symbols to identify the actual field devices of a process loop (PID) and control loop (electrical elementary print). Explain and document the basic operation of the devices and

equipment for both the process (PID) and control (electrical elementary print) loops. (TN Reading 2, 3, 4, 7)

Single-Phase Transformer

19) Explain the operation of a basic single-phase transformer. Given the following scenarios, examine and confirm that the transformer is operating correctly. Write a brief justification supporting the conclusion of each examination. In groups or as a class, discuss results and provide constructive feedback.
    a. Single-phase step-up transformer
    b. Single-phase step-down transformer
    c. Single-phase isolation transformer
    d. Single-phase current transformer
    (TN Reading 2, 3, 4; TN Writing 2, 4, 5; TN Math N-Q)

Conductors and Cables

20) Given a proposed addition to a commercial electrical system, properly select type and size of both conduit and conductors for an installation. Support the selection with evidence drawn from standards in the National Electrical Code (NEC) and local codes. (TN Reading 2, 3, 4, 9; TN Math N-Q)

21) Demonstrate an understanding of how to physically read and identify markings on conductors and cables according to industry standards such as the National Electrical Code (NEC). Explain how conductors and cables are categorized based upon wire size and gauge, insulation and jacket types, and voltage ratings. (TN Reading 2, 3, 4; TN Math N-Q)

Conduit Installation

22) Given an assignment to install a specified run of electrical metal tubing (EMT) and polyvinyl chloride (PVC) conduit, create and execute a written plan of the procedure to be completed. The plan should include, but is not limited to the following:
    a. Where and why bends (e.g., stub, offset, saddle, parallel) will be used
    b. How the material will be cut, reamed, installed, and secured
    c. Drawings of how the conduit will be secured with clamps and fittings conforming to standards of the National Electrical Code (NEC) and local codes.
    (TN Reading 3, 4, 7; TN Writing 2, 4; TN Math N-Q)

23) Given an assignment to install a specified run of intermediate metal conduit (IMC) and rigid conduit, create and execute a written plan of the procedure to be completed. The plan should include, but is not limited to, the following:
    a. Where and why bends (e.g., stub, offset, saddle, parallel) will be used
    b. How the material will be cut, reamed, installed, and secured
    c. Drawings of how the conduit will be secured with clamps and fittings conforming to standards of the National Electrical Code (NEC) and local codes.
    (TN Reading 3, 4; TN Writing 2, 4; TN Math N-Q)

24) Develop a written plan, then set up and execute a cable pull through assorted conduit and cable tray configurations. The plan should include a list of the tools used, diagrams of puller systems used, an explanation of how the proper location was selected to start and end the conductor pull, as well as calculations for allowable pulling tension for a specified group of conductors. Justify the written plan with supporting evidence based on observations and prescriptions outlined in the National Electrical Code (NEC). (TN Reading 2, 3, 4, 8, 9; TN Writing 2, 4, 5; TN Math N-Q)

Computers and Electronics

25) Given a set of logic statements and schematic circuits, construct the logic circuits described using the following:
     a. AND, OR, NOR, and XOR gates
     b. Flip-flops, counters, and gates
   Document and define each logic gate including a drawing, a description of its function in a short sentence or paragraph, a specification of each truth table, and the equation for each gate. (TN Reading 2, 4; TN Writing 2, 4)

26) Given a working programmable logic controller (PLC), an operator interface, and interfacing computer, safely set up a communication loop in order to view and explain the program's purpose. Identify and explain the functions and interrelationships among the following PLC components:
     a. Power supply
     b. CPU
     c. Input modules
     d. Output modules
     e. Analog input and/or modules
   (TN Reading 2, 3)

Motors

27) Given a specified application in an electromechanical system, properly select a motor based upon its intended use. Using resources such as technical manuals and industry standards, determine the size, speed, operating voltage, and National Electrical Manufacturing Association (NEMA) type for the required motor. Present a justification of the selection to classmates. Be prepared to answer any questions with evidence to support the selection. (TN Reading 3, 4; TN Writing 1, 4; TN Math N-Q)

28) Consult multiple sources such as National Electrical Code (NEC), Occupational Safety and Health Administration (OSHA) regulations, and given installation drawings. Using this information, determine the required over-current protection, motor control circuits, conductor types and sizes, and conduit types and sizes for a given motor and application. Write a technical report that compares and contrasts the selections with those of other classmates. Provide supporting evidence for any selections that differ from classmates, and work together to come to a consensus on requirements and collaboratively write a final report. (TN Reading 2, 3, 4, 9; TN Writing 2, 4, 6; TN Math N-Q)

29) Plan and execute the selection, installation, and wiring of the following motors. Document the plan and explain the detailed multistep process used to complete the procedure by the requirements of the National Electrical Code (NEC) and Occupational Safety and Health Administration (OSHA) regulations.
    a. DC motor (other than a permanent magnet motor)
    b. Single-phase capacitor motor
    c. Reversing three-phase motor
    (TN Reading 2, 3, 4; TN Writing 2, 4; TN Math N-Q)

Drive Systems

30) Identify and demonstrate an understanding of the components in typical mechanical drive systems (e.g., gear and belt drive) within an industrial setting. Compare and contrast gear versus belt drives and explain the differences between them. Simulating a period of production downtime, safely and correctly disassemble and reassemble both a gear driven mechanical drive and a belt driven mechanical drive in a specified amount of time. (TN Reading 2, 3, 4; TN Math N-Q)

Calibration and Instrumentation

31) Examine a smart instrument (used to measure pressure flow, temperature, or level) and its corresponding communicator. Identify the basic parameters of the instrument such as tag number and calibration range. Plan and execute the setup of a communication loop and demonstrate how to calibrate the instrument by changing various parameters. (TN Reading 3, 4; TN Math N-Q)

Hydraulic Systems

32) Review drawings and interpret American National Standards Institute (ANSI) symbols to explain the function of a basic industrial hydraulic system. Develop a written text that outlines, describes, and logs recommended regular preventative maintenance on hydraulic equipment and controls. Use the text as a guide to execute the recommended procedures and record the details of the maintenance, explaining how the preventative maintenance will minimize failures in hydraulic equipment. (TN Reading 2, 3, 4, 9; TN Writing 1, 4)

Pumps

33) Identify and explain the operation and basic parts of gear, centrifugal, and positive displacement pumps found in an industrial setting. Simulating a period of production downtime, safely and correctly disassemble and reassemble each type of pump (e.g., gear, centrifugal, and positive displacement) within a specified amount of time. (TN Reading 2, 3, 4; TN Math N-Q)

Pipe Fabrication

34) Inspect and interpret assembly drawings for piping in a typical industrial setting. Given multiple general piping parts, select necessary parts to assemble both a bolted flange and a screw flange. Describe the multistep process used and provide evidence to support the selections that were made. (TN Reading 2, 3, 4; TN Math N-Q)

Troubleshooting

35) Assess blueprints of a typical electromechanical system (e.g., motor driving a pump with a coupling, an instrumentation loop, etc.) and examine a given section of the system. Follow a troubleshooting procedure and identify the problems in a malfunctioning system within a specified time. Citing evidence from blueprints and other resources, document the problem(s), explain the nature of the malfunction, and prescribe a recommended solution. ~~(TN Reading 2, 3, 4, 9; TN Writing 1, 4, 8; TN Math N-Q)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Geometry.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Digital Electronics

Primary Career Clusters:	Advanced Manufacturing and Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5925
Pre-requisite(s):	*Algebra I* (0842, 3102)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing or STEM courses.
Programs of Study and Sequence:	This is the second course in the *Mechatronics* and *Technology* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046),(044 and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760
Required Teacher Certifications/Training:	Some endorsements require NIMS industry certification to teach this course. Please refer to the correlation of course codes for a full list.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing https://tn.gov/education/article/cte-cluster-stem

Approved January 30, 2015; Amended April 15, 2016

Course Description

Digital Electronics is intended to provide students with an introduction to the basic components of digital electronic systems and equip them with the ability to use these components to design more complex digital systems. Proficient students will be able to (1) describe basic functions of digital components (including gates, flip flops, counters, and other devices upon which larger systems are designed), (2) use these devices as building blocks to design larger, more complex circuits, (3) implement these circuits using programmable devices, and (4) effectively communicate designs and systems. Students develop additional skill in technical documentation when operating and troubleshooting circuits. Upon completion of the *Digital Electronics* course, proficient students will be able to design a complex digital system and communicate their designs through a variety of media. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Mechatronics* and *Technology* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Advanced Manufacturing and STEM websites at https://tn.gov/education/article/cte-cluster-advanced-manufacturing and https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules including (1) rules published by the National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, and (4) state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. ~~(TN Reading 3, 4)~~

Citizenship and Career Exploration

3) In teams, develop a persuasive paper or presentation arguing for the importance of electrical and/or computer engineers' contributions to society. Select several such contributions as justification, and provide compelling evidence for how electrical/computer engineers' designs are used in everyday applications. Incorporate a variety of sources to gather data, including print and electronic; cite each source, and briefly describe why the particular source is reliable. ~~(TN Reading 1, 7; TN Writing 1, 4, 6, 7, 8, 9)~~

4) Research the postsecondary institutions in Tennessee that offer electrical engineering or electrical and/or computer engineering technology. Individually or in teams, develop and publish information that identifies admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare students for success after high school in electrical or computer engineering fields. Cite each source adhering to standard citation conventions used in engineering disciplines. (TN Reading 7, 9; TN Writing 2, 4, 6, 7, 8)

Gates in Logic Circuits

5) Identify each type of logic gate with a drawing, a description of its function in a short sentence or paragraph, a specification of each truth table, and the equation for each gate (buffer, inverter, AND, NAND, OR, NOR, XOR [difference], and XNOR [equivalence]), including the valid number of input(s) and output(s) for each gate. (TN Reading 2, 4; TN Writing 2, 4)

6) Define D and JK flip flops by including a drawing, a description of the function in a short sentence or paragraph, and a specification of each truth table and equation. The description should explain how the "clock" signal is related to the flip flop. (TN Reading 2, 4, 7; TN Writing 4)

7) In teams, design three (or more) combinational (without a clock signal) devices to a scale that would be typically implemented in a medium-scale integrated circuit (MSI: typically 10-1000 gates). One of the devices should incorporate XOR / XNOR gates. Examples of devices include 4-bit or greater versions of the following: adder/subtractor, comparator, multiplexer, and calculator. Upon completion of the design, develop a technical presentation providing an overview of the device and its specifications, an accompanying schematic, and a list of the gates used. Present the project to classmates and refine the presentation based on their feedback. (TN Writing 2, 4, 6, 7, 10)

8) Working in teams, develop and publish information detailing a rich description of one of the combinational projects, and including a schematic and summary of test results If a prototyping system is available in the classroom (Xilinx, Altera, or similar), physically test the project and report results. If possible, include a video of the test. Present the project to the class, and revise based on peer feedback. (TN Writing 4, 5, 6, 7)

9) Design a counter with up to 32 states and write an explanatory text describing how the counter operates using technical and domain-specific vocabulary. Provide a state diagram and draw a schematic for the circuit using D or JK flip flips. (TN Reading 4, 7; TN Writing 2, 4, 7)

Counters in Logic Circuits

10) In teams, design two (or more) sequential devices that utilize a counter. For example, design a traffic light system with two turn arrows. Create a poster presentation that could be shown at a science fair or career and technical student organization (CTSO) with a description of the device, an accompanying schematic, and a list of the gates used. (TN Writing 2, 4, 6, 7)

Oscillators in Logic Circuits

11) In teams, design a clock signal using a 555-timer in an astable monovibrator configuration. Simulate the design and/or build a prototype and measure the output frequency. If instrumentation to measure the frequency is not available (an oscilloscope for example), a clock frequency timed using a stopwatch can be used as an alternative. Compare and contrast the prediction of the outcome with actual results. Develop a presentation to explain the circuit design, the prediction, and the results from the simulation or prototype. *Note: The instructor may wish to constrain the output frequency by supplying a resistor value and/or a capacitor value.* (TN Reading 3, 4, 9; TN Writing 7; TN Math N-Q)

12) In teams, design a counter with between 16 and 32 states. Clock the counter using an oscillator of known frequency, and predict the frequency from each output (each bit in the counter). Simulate the counter to verify the prediction. If possible, the counter should be physically prototyped to verify the prediction and simulation. Calculate the error between the prediction and simulation or prototype. Produce a technical report to summarize findings. (TN Reading 3, 4; TN Writing 4, 6, 7; TN Math N-Q)

Multiplexers in Signal Distribution

13) Design a circuit with 4-8 signals and use a multiplexer to select one of the signals as the output, then simulate the circuit. Develop and deliver a presentation describing the inputs, explaining the circuitry used to select the channel to output, and featuring a timing diagram illustrating the successful operation of the circuit. (TN Reading 3, 4; TN Writing 2, 4, 7)

14) In teams, design a 4-channel multiplexer using gates. Simulate or build a prototype of the circuit, and demonstrate it to the class. Participate in a class discussion that compares and contrasts the various designs exhibited. As a class, determine the best design and provide supporting evidence from observations and functionality to justify the decision. (TN Reading 3, 4; TN Writing 7)

Functions of Analog and Digital Convertors

15) In teams, design a circuit using an A/D converter to measure the temperature in the room. Specify the assumptions made for minimum and maximum temperatures, and calculate the resolution (step) of the system. Upon completion of the circuit, write a technical specification of the design; then present the design and technical specifications to the class, including a graph showing the input and output values. Using the feedback from classmates, write a summary describing how the design could be revised and improved in future projects. *Note: Instructors may substitute a similar project in which a continuous and limited quantity is measured.* (TN Reading 3, 4; TN Writing 2, 4, 5, 7; TN Math N-Q, A-REI, S-ID)

16) Using multiple print and digital sources, research the uses for A/D and D/A converters in a current technical device. For example, describe how data acquisition systems in race cars use A/D and D/A converters. Draw on the research findings to develop talking points and participate in a mock public forum on the uses for A/D and D/A converters. (TN Reading 3, 4, 5; TN Writing 4, 6, 7; TN Math N-Q)

Program Microcontrollers

17) Sketch and describe a block diagram of a computer system, detailing at least the following components:
   a. Microcontroller / microprocessor
   b. Cache
   c. RAM (Random Access Memory)
   d. Large-scale memory
   e. Input devices
   f. Output devices (monitor[s])

   Show the proper connections between each component, such as data bus and address bus connections. Using visual aids, present and explain the block diagram to the class. (TN Reading 1, 4; TN Writing 4, 5)

18) In teams, program a microcontroller-based system to perform a series of tasks. The microcontroller should be part of a larger system. Upon completion of the programming, write a technical report summarizing the functions and intended uses of the end product. Include the specifications of the series of tasks performed by the microcontroller and the programming code with comments for each function. Present the design to the class, and revise the report based on feedback from peers. (TN Reading 2, 3, 4, 9; TN Writing 2, 4, 5, 7, 8)

Technical Documentation and Troubleshooting

19) Consult technical documents (such as data sheets, timing diagrams, operating manuals, and schematics) of digital components (TTL, CMOS, etc.) to develop a troubleshooting methodology for a digital circuit that could be used by a new technician. Create and deliver a presentation demonstrating the troubleshooting procedure for the class. (TN Reading 3, 4, 5, 7; TN Writing 2, 4, 9)

Projects

20) In teams, identify a problem requiring a digital circuit (including A/D, D/A conversion and/or a microprocessor). Follow the design process to solve the problem using digital electronics. Develop a written report documenting the solution, including a background section describing the problem which cites written or electronic sources and documentation of each stage in the design process. Build a prototype proof-of-concept if feasible. Present the problem, the design process used, and the developed solution to the class and other technical or non-technical audience members (e.g., parents, teachers, school administrators, STEM professionals, etc.). The final report draft should be critiqued by a different student team or outside expert. Thereafter, incorporate feedback to refine the report and submit a final version. (TN Reading 6, 7, 8, 9; TN Writing 2, 4, 5, 6, 9, 10)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Mechatronics I

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6156
Prerequisite(s):	*Algebra I* (0842, 3102), *Geometry* (0843, 3108), *Physical Science* (3202), and *Digital Electronics* (5925)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Manufacturing courses.
Programs of Study and Sequence:	This is the third course in the *Mechatronics* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	If a student successfully completes both Mechatronics I and II, he or she is eligible to sit for Level 1 Siemens Certified Mechatronic Systems Assistant certification.
Dual Credit or Dual Enrollment Opportunities:	There are currently dual enrollment opportunities with specific community colleges, such as Motlow State Community College.
Teacher Endorsement(s):	157, 232, 233, 470, 477, 523, 537, 551, 552, 582, 596, 701, 760
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Mechatronics I is an applied course in the manufacturing cluster for students interested in learning more about careers as a mechatronics technician, maintenance technician, electromechanical technician, and manufacturing engineer. This first of two courses covers basic electrical and mechanical components of mechatronics systems as well as their combined uses with instrument controls and embedded software designs. Upon completion of this course, proficient students are able to describe and explain basic

functions of physical properties and electrical components within a mechatronic system. They can logically trace the flow of energy through a mechatronic system and can communicate this process to others. They know how to effectively use technical documentation such as data sheets, schematics, timing diagrams, and system specifications to troubleshoot basic problems with equipment. Finally, they develop strategies to identify, localize, and correct malfunctioning components and equipment. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the third course in the *Mechatronics* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Mechatronics Overview

1) Drawing on various media, including visual, quantitative, and written resources, trace the historical development of the four facets (mechanical systems, electronic systems, computers, and control systems) of a mechatronic system and explain their chief applications in modern society, citing specific textual evidence. ~~(TN Reading 1, 2)~~

2) Citing specific evidence from a textual description or actual observation of a mechatronic system, describe the flow of electrical and mechanical energy in the system. Create a computational model to represent the transfer of energy from one component to others in a system. ~~(TN Reading 1, 7)~~

Safety

3) Accurately read and interpret safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA), state and national code requirements. Apply them accordingly while working on electrical and mechanical components and explain why certain rules apply. ~~(TN Reading 3)~~

Electronics

4) Demonstrate understanding of the specific roles of various electrical components discerned in a circuit schematic by correctly predicting the effects of changing selected parameter values. For example, predict the effect of halving a resistor's value. Compare and contrast these roles and explain how electronic designs vary within a given system or module. ~~(TN Reading 3, 9)~~

5) Create, measure, and analyze basic director current (DC) circuits prescribed by schematics using Ohm's law, Kirchhoff's law, and Watt's law to predict and verify circuit behavior. Apply understanding of these laws to troubleshoot simple circuits, and document the steps required to remedy the trouble. ~~(TN Reading 3, 4; TN Writing 4; TN Math N-Q, A-REI, A-SSE, F-IF)~~

6) Create, measure, and analyze circuits prescribed by schematics to predict and verify the behavior of series versus parallel DC circuits or resistances. Where unexpected behavior is observed, cite specific evidence to explain the observations. ~~(TN Reading 1)~~

7) Using technical documentation, such as manuals and schematics, craft an informative narrative to explain the physical operation of electromagnetic and electrostatic components (such as coils, solenoids, relays, and various sensors) in a mechatronic system. Interpret resolved work orders by analyzing underlying issues and explaining the correct physical operation of the included components. ~~(TN Reading 6, 8; TN Writing 2~~)

8) Create, measure, and analyze circuits prescribed by schematics to predict and verify the behavior of the electrical and physical properties of components (such as resistors, capacitors, diodes, transformers, relays, and power supplies). Report findings explaining the typical application and operation in circuits of the previously listed components, citing measurement and/or observed evidence supporting the explanation. ~~(TN Reading 8; TN Writing 4)~~

Mechanical

9) Demonstrate understanding of the specific role of various mechanical components in mechatronic systems, discerning in a system schematic the effects of various design parameters on the system behavior. For example, predict the effect of a larger gear size. Compare and contrast these roles in the context of mechatronic systems, modules, and subsystems, explaining how designs vary within a given system or module. ~~(TN Reading 3, 9)~~

10) Create, measure, and analyze mechanical systems prescribed by drawings to predict and verify the behavior of the physical operation of components in a mechatronic system, including but not limited to:
    a. Springs, and spring-like effects
    b. Dampers and energy dissipation
    c. Masses (weights)
    Craft an explanatory narrative to report findings and outline the typical application in systems of the components listed above, citing the observed behavior to support explanations. ~~(TN Reading 3, 9; TN Writing 2)~~

11) Interpret technical information in design problems to analyze forces, speeds, torque, and power, for mechanical drives including:
    a. Gears, cams, screws, and levers
    b. Belt and chain drives
    c. Flywheels
    d. Motors and generators
    Explain the typical application and operation in systems of the components listed above, citing measurement and/or observed evidence to support explanations. Create equations that describe relationships to solve the design problems and justify the solutions. ~~(TN Reading 4; TN Math A-CED)~~

12) Research and measure the behavior of different types of alternating current (AC) motors and direct current (DC) motors, comparing and contrasting behaviors and drawing inferences from the observations to create a checklist for use by a technician to ensure proper functioning of equipment. (TN Reading 1, 9; TN Writing 4)

13) Referencing appropriate technical documents (such as data sheets, timing diagrams, operating manuals, and schematics), design an experiment to observe and measure the mechanical properties and behavior of shafts, couplings, and sealing devices with and without proper lubrication. Document research and measurement results in a technical report to be used by other technicians. (TN Reading 1, 3; TN Writing 2, 7, 9)

14) Demonstrate understanding of power transmission components, such as clutches and brakes, by measuring the operation of working automotive equipment. Create a graphic illustration showing the roles of each component and how they work together in a system. (TN Reading 7)

15) Assess the required maintenance for a variety of mechatronic system components in a mechatronic device, and carry out the necessary adjustments to the system. Document and justify the adjustments in an equipment log that can be easily referenced by technicians and engineers. (TN Reading 3; TN Writing 2)

Technical Documentation and Troubleshooting

16) Consult technical documents (such as data sheets, timing diagrams, operating manuals, and schematics) to assess a mechatronic system and effectively troubleshoot the malfunctions in electrical components. Record and analyze test results and prepare written testing documentation to justify a solution. (TN Reading 5, 9; TN Writing 1, 2)

17) Verify by observation and measurement the parts, relationships, and behavior depicted by the technical data sheets for the mechanical and electrical components within a mechatronic system. Use these data sheets to create a training document to instruct a new technician on maintaining and operating these components and drives. (TN Reading 4, 5; TN Writing 2)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, 8, and 10 at the conclusion of the course.

- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Mechatronics II

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6157
Prerequisite(s):	*Mechatronics I* (6156) and *Physics* (3231) Note*: Physics* (3231) may be taken as a co-requisite.
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Manufacturing courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Mechatronics* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	If a student successfully completes both *Mechatronics I* and *II*, he or she is eligible to sit for Level 1 Siemens Certified Mechatronic Systems Assistant certification.
Dual Credit or Dual Enrollment Opportunities:	There are currently dual enrollment opportunities with specific community colleges, including Motlow State Community College.
Teacher Endorsement(s):	157, 232, 233, 470, 477, 523, 537, 551, 552, 582, 596, 701, 760
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Course Description

Mechatronics II is an advanced course in the manufacturing career cluster for students interested in learning more about such careers as mechatronics technician, maintenance technician, or

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electromechanical technician. Following the groundwork of mechanics and electronics laid in *Mechatronics I*, this course covers basics of pneumatic, electro pneumatic, and hydraulic control circuits in a complex mechatronic system. In addition, the course addresses basic digital logic and programmable logic controllers (PLCs) employed in the mechanical, electronic, and control systems in a mechatronics system. Upon completion of this course, proficient students are able to explain the inter-relationships of components and modules within a complex mechatronic system. They understand the differences between hydraulic and pneumatic fluid power and can explain the scientific principles that apply. They also use technical documentation (such as datasheets, circuit diagrams, displacement step diagrams, timing diagrams, and function charts) to troubleshoot and resolve malfunctioning pneumatic and hydraulic components and circuits. They demonstrate understanding of the role of programmable logic controllers (PLC) in mechatronic systems and the ability to write, debug, and run basic ladder logic. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the fourth course in the *Mechatronics* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to the rules of handling high-pressure pneumatics and hydraulics. Analyze the implications of the various rules and employ them accordingly while working on mechatronic systems with control system components, explaining why certain rules apply. ~~(TN Reading 1, 3)~~

Fluid Power Systems

2) Demonstrate understanding of the interrelationships and specific roles of (electro) pneumatic and hydraulic components and modules within a complex mechatronic system. For example, provide a written technical description of the expected changes in one or more systems on other components and modules in the total mechatronic system. ~~(TN Reading 9; TN Writing 2)~~

3) Identify the differences between hydraulic and pneumatic fluid power and justify decisions surrounding when to use control systems based on one component as opposed to the other by crafting and defending an argument with specific claim(s), reasoning and supporting evidence. ~~(TN Reading 9; TN Writing 1)~~

4) Create laboratory setups or simple control systems that apply hydraulic and pneumatic principles such as Boyle's Law and Pascal's Law. Apply these principles to solving problems and troubleshooting mechatronic systems, explaining the reasoning behind each step. ~~(TN Reading 5; TN Math A-REI)~~

5) Using real-world examples of hydraulic/pneumatic systems, and citing reputable print and visual sources of such systems, conduct research to identify the basic components and functions in a fluid power system. Create a visual aid to summarize and explain this information to technicians or upper management. (TN Reading 7; TN Writing 6)

6) Measure and analyze basic physical properties of (electro) pneumatic and hydraulic components (such as cylinders, directional control valves, regulators, flow control valves, pumps, and motors) within a given system. Interpret resolved work orders by analyzing underlying issues and explaining the correct physical operation of the included components. (TN Reading 6, 8; TN Writing 2)

7) Citing evidence from a technical description or actual observation of a mechatronic system, describe the flow of fluid energy in a given mechatronic system or subsystem. Create a graphic illustration to represent the transfer of energy from one component to others in the system. (TN Reading 1; TN Writing 4)

Computers and Control Systems

8) Research the different roles of programmable logical controllers (PLCs) in complex mechatronic systems, modules, and subsystems, and be able to verbally describe their components and operation to others. Collaboratively create a technical document for a new technician that explains the basic components of a PLC, addressing how the role of a PLC varies in different systems (such as mechatronic systems, modules, and subsystems). (TN Reading 6, 9; TN Writing 2, 6)

9) Demonstrate understanding of the flow of information in a given mechatronic system or subsystem, focusing on the control function of PLCs in the system. Create both a schematic and explanatory narrative to describe the flow of information to/from an equipment operator. (TN Reading 4, 7; TN Writing 2, 4)

10) Given a control scenario, bound by several logical parameters, create Boolean logic equations to prescribe the use of logic gates in the implementation of the scenario. Show how they apply to the functioning of a real-world mechatronics system, explaining the reasoning involved. (TN Reading 4; TN Writing 4; TN Math A-CED; A-REI)

11) Demonstrate understanding of hexadecimal, decimal, octal, binary, 2s complement, and binary coded decimal (BCD) values as used in a common PLC. Write an explanation or develop and deliver a brief presentation of how these codes are relevant to mechatronic systems. (TN Reading 4, 7; TN Writing 2)

12) Convert wiring and ladder diagrams for simple logic chores into PLC programs that use common instructions such as digital, logical, compare, compute, move, file, sequencer, and program control instruction sets. (TN Reading 3; TN Writing 4, 9; TN Math A-REI)

Technical Documentation and Troubleshooting

13) Referencing technical documents (such as data sheets, circuit diagrams, displacement step diagrams, timing diagrams, function charts, operations manuals, and schematics) for pneumatic and hydraulic components within a mechatronic system, assess the required maintenance for such systems, taking appropriate measurements where needed, and perform the necessary adjustments on these systems. Document and justify adjustments in an equipment log that can be referenced by technicians and engineers. ~~(TN Reading 3, TN Writing 2, 8)~~

14) Troubleshoot malfunctioning pneumatic and hydraulic systems: identify the source of the problem(s), plan a multistep procedure to correct the malfunction, implement the plan, and verify the corrective action. Using appropriate technical language and terminology, document the cause of the malfunction and justify the procedure used to correct it. ~~(TN Reading 3, 4, 9; TN Writing 1, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 2 and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 7, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Algebra.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate algebraic reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning.
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Welding I

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6078
Pre-requisite(s):	*Principles of Manufacturing* (5922) Recommended: *Algebra* (0842, 3102), *Geometry* (0843, 3108), and *Physical Science* (3202)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the second course in the *Welding* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are available known dual credit/dual enrollment opportunities for this course. If interested, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	551, 552, 553, 554, 555, 556, 557, 584, 705, OR any other Occupational License endorsement with AWS Industry Certification, BAT, or Certified Welding Educator Certification
Required Teacher Certifications/Training:	Must hold AWS Industry Certification, BAT, or Certified Welding Educator Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved January 30, 2015; Amended April 15, 2016

Course Description

Welding I is designed to provide students with the skills and knowledge to effectively perform cutting and welding applications used in the advanced manufacturing industry. Proficient students will develop proficiency in fundamental safety practices in welding, interpreting drawings, creating computer aided drawings, identifying and using joint designs, efficiently laying out parts for fabrication, basic shielded metal arc welding (SMAW), mechanical and thermal properties of metals, and quality control. Upon completion of this course, proficient students will understand the requirements to pursue the American Welding Society (AWS) Entry Welder qualification and examination and will be prepared to undertake more advanced welding coursework. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Welding* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials; ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4; TN Writing 2, 4)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment. ~~(TN Reading 3, 4)~~

Career Exploration

3) Locate and assess the American Welding Society website and analyze its structure, policies, and requirements for the AWS Entry Welder qualification and certification. Explain a welder certification document, what steps are required to obtain the certification, and how to prepare for the examination. ~~(TN Reading 2, 3, 4)~~

Interpreting and Creating Drawings

4) Compare and contrast the architectural scale versus the engineering scale used in mechanical drawings. Describe their distinguishing characteristics. Define a scale and perform conversion calculations of various distances. ~~(TN Reading 3, 4; TN Math N-Q)~~

5) Building on the knowledge of a two-dimensional drawing, create simple isometric (3-D pictorial) drawings, properly using lines (e.g., object, hidden, center), labels, and dimensioning techniques. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

Welding Design and Layout

6) Identify, sketch, and explain the five basic weld joint designs (e.g., butt, lap, tee, outside corner, and edge). Find examples of various joint designs applied to structures on or around campus and take pictures to present to classmates. (TN Reading 1, 2, 7; TN Math G-GMD)

7) Demonstrate proper laying out of parts for fabrication by marking lines and locating points for cutting, bending, drilling, and assembling. Identify the factors that influence effective layout and explain how to maximize the desired outcome. For example, plan the placement of parts together so as to minimize the waste of stock material. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math N-Q, G-GMD)

Shielded Metal Arc Welding (SMAW)

8) Safely set up equipment for shielded metal arc welding (SMAW). Identify and explain the equipment, equipment setup, and the electrical current used in the welding process. Drawing on multiple resources, compare and contrast SMAW with other welding and cutting processes such as oxyfuel gas welding (OFW), gas metal arc welding (GMAW), flux-cored arc welding (FCAW), and gas tungsten arc welding (GTAW). Write a brief informative paper discussing the distinguishing characteristics and primary advantages of each. (TN Reading 2, 4, 5, 7; TN Writing 2, 4)

9) Demonstrate how to make single- and multiple-pass fillet welds and groove welds with backing on plain carbon steel in the following positions. Prior to welding, sketch a cross section, including the dimensions of each weld demonstration.
   a. Flat
   b. Horizontal
   c. Vertical
   d. Overhead
   (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math N-Q, G-GMD)

10) Research the American Welding Society (AWS) filler metal classification system and write a paper explaining the system, briefly discussing the multiple factors that affect electrode selection for shielded metal arc welding (SMAW). Using various electrodes, demonstrate how to make pad beads on plain carbon steel in the following positions.
   a. Flat
   b. Horizontal
   c. Vertical
   d. Overhead
   Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4, 7; TN Math N-Q, G-GMD)

Properties of Metals

11) Research the following mechanical properties of metals and their importance in the welding process.
    a. Tensile
    b. Strength
    c. Hardness
    d. Elasticity
    e. Ductility
    f. Toughness
    g. Brittleness
Create a chart or table that compares and contrasts the meaning of these properties. Explain the changes in the mechanical properties of weldments that occur during the welding process. (TN Reading 2, 4, 5, 6, 7; TN Writing 2, 4, 9)

12) Investigate the thermal properties of metals and their effects on welding processes. Describe and demonstrate techniques to mitigate the effects of thermal expansion and contraction that occur during the welding process. During the demonstrations, observe and record the changes that occur in the mechanical properties of weld and parent metals caused by heating and cooling. Write a report summarizing and explaining the findings. Justify all explanations with supporting evidence gathered from observations and welding principles. (TN Reading 3, 4, 5, 7, 8; TN Writing 2, 4, 5)

13) Design an experiment to test and compare the effect that thermal conductivity and specific heat have on various metals such as steel and aluminum. Record all observations and write a report to present the test results in an electronic format, integrating quantitative and visual information. The report should include, but should not be limited to, explaining the effect of thermal conductivity on the heating and cooling rates observed during the welding process, as well as the effect of specific heat on heat rates required for welding. (TN Reading 3, 4, 5, 7; TN Writing 2, 4, 5, 6, 7, 8, 9)

Quality Control

14) Drawing upon multiple resources, research and write a text explaining the relationship between discontinuities and defects. Describe various examples of defects found in welded products. Also identify and explain both destructive and nondestructive tests used as quality control techniques to prevent manufacturing defects in welding. Compare and contrast these techniques and provide specific examples when they are most appropriately used. Cite evidence to justify the examples. (TN Reading 1, 3, 5, 7, 9; TN Writing 1, 4)

15) Measure and visually inspect welded products for acceptability to American Welding Society QC-10 standards. Record discontinuities and defects, and compare data to given project specifications using class-defined analysis methods. Interpret and communicate results both written and verbally. If necessary, recommend changes that will reduce the number of product defects during the manufacturing process. (TN Reading 1, 3, 4, 7; TN Writing 1, 4; TN Math N-Q, G-GMD)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Welding II

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6033
Pre-requisite(s):	*Welding I* (6078) Recommended: *Algebra* (0842, 3102), *Geometry* (0843, 3108), *Physical Science* (3202)
Credit:	2
Grade Level:	11-12
Graduation Requirement:	This course satisfies two of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the third course in the *Welding* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	American Welding Society Entry Welder
Dual Credit or Dual Enrollment Opportunities:	There are available dual credit/dual enrollment opportunities for this course. If interested, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	551, 552, 553, 554, 555, 556, 557, 584, 705, OR any other Occupational License endorsement with AWS Industry Certification, BAT, or Certified Welding Educator Certification.
Required Teacher Certifications/Training:	Must hold AWS Industry Certification, BAT, or Certified Welding Educator Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved January 30, 2015; April 15, 2016

Course Description

Welding II is designed to provide students with opportunities to effectively perform cutting and welding applications of increasingly complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the *Welding I* course and apply them in novel environments, while learning additional welding techniques not covered in previous courses. Specifically, students will be proficient in (1) fundamental safety practices in welding, (2) gas metal arc welding (GMAW), (3) flux cored arc welding (FCAW), (4) gas tungsten arc welding (GTAW), and (5) quality control methods. Upon completion of the *Welding II* course, proficient students will be eligible to complete the American Welding Society (AWS) Entry Welder qualification and certification. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.~~*

Program of Study Application

This is the third course in the *Welding* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials; ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4; TN Writing 2, 4)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment. ~~(TN Reading 3, 4)~~

Gas Metal Welding (GMAW)

3) Safely set up equipment for gas metal arc welding (GMAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, research the advantages of using GMAW over conventional electrode-type arc (stick) welding. Write a brief informative paper distinguishing the characteristics. For example, explain why it is easier to control the small molten weld pool using the GMAW process. ~~(TN Reading 2, 4, 5, 7, 9; TN Writing 2, 4)~~

4) Research the American Welding Society (AWS) filler metal classification system, and write a brief paper explaining the system, discussing the multiple factors that affect electrode selection for gas metal arc welding (GMAW). For example, the 80 in ER80S-D2 designates the minimum tensile strength of the deposited weld metal in thousands. ~~(TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4)~~

5) Using the gas metal arc welding (GMAW) process and various metal transfer methods (e.g., short-circuit, pulse-arc, globular, and spray transfer), demonstrate how to pad beads and make fillet welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead). Summarize the demonstration results, distinguishing between the metal transfer methods used, and explain the equipment adjustments made to change between metal transfer methods as if narrating a technical process to an audience. (TN Reading 3, 4, 5, 7; TN Writing 2, 4; TN Math N-Q, G-GMD)

Flux Cored Arc Welding (FCAW)

6) Safely set up equipment for flux cored arc welding (FCAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, research the advantages and limitations of FCAW. Write a brief informative paper distinguishing these characteristics. For example, determine which types of metals and alloys are most applicable for the use of FCAW. (TN Reading 2, 4, 5, 7, 9; TN Writing 2, 4)

7) Refer to previous research conducted on the filler metal classification system by the American Welding Society (AWS). Using proper domain-specific terminology, explain in a presentation to a technical audience the multiple factors that affect electrode and shielded gas selection for flux cored arc welding (FCAW). For example, manufacturers sometimes consider the exact composition of fluxes a trade secret and do not provide enough details to classify electrodes. As a result, AWS uses G for electrodes that have not been classified. (TN Reading 2, 4, 5, 6, 7; TN Writing 2, 4)

8) Using various electrodes and the flux cored arc welding (FCAW) process, demonstrate how to pad beads and make fillet welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead). Over time, routinely document observations such as the effects of metal surface conditions, voltage drop, welding position, and wire feed speed. Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system and other resources. (TN Reading 3, 4, 5, 7; TN Writing 2, 4; TN Math N-Q, G-GMD)

9) Identify and explain the following distinctive features about flux cored arc welding (FCAW): arc-control, oxidation-prevention, self-shielded FCAW, and gas-shielded FCAW. Describe and demonstrate specific examples of how metal transfer is affected by arc-control, self-shielded, and gas-shielded FCAW. Explain the importance of using recommended gas mixtures. (TN Reading 2, 4, 5, 7; TN Math N-Q)

Gas Tungsten Arc Welding (GTAW)

10) Safely set up equipment for gas tungsten arc welding (GTAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, compare and contrast water-cooled welding torches versus air-cooled welding torches used in GTAW. Write a brief paper distinguishing the characteristics and the appropriate applications of each torch type. For example, determine which torch is preferred in production welding contexts and explain why. (TN Reading 2, 4, 5, 7, 9; TN Writing 2, 4)

11) Refer to previous research conducted on the filler metal classification system by the American Welding Society (AWS). Discuss the multiple factors that affect electrode selection for gas tungsten arc welding (GTAW). For example, pure tungsten (EWP) is not typically used with alternating current (AC) welding of materials because it has poor heat resistance and electron emission. (TN Reading 2, 3, 4, 5, 7, 9; TN Writing 2, 4)

12) Using various electrodes and the gas tungsten arc welding (GTAW) process, demonstrate how to pad beads and make fillet welds on plain carbon steel, stainless steel, and aluminum in all feasible positions (e.g., horizontal, flat, vertical, overhead). Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system and other resources. (TN Reading 3, 4, 5, 7; TN Writing 2, 4; TN Math N-Q, G-GMD)

13) Identify and explain the following distinctive features about gas tungsten arc welding (GTAW): arc-control, oxidation-prevention, and gas-shielded GTAW. Describe and demonstrate specific examples of how metal transfer is affected by various shielded gas GTAW (e.g., argon, helium, hydrogen, nitrogen). Identify which gases are noble inert gases and explain why this is a distinguishing characteristic. (TN Reading 2, 4, 5, 7, 9; TN Math N-Q, G-GMD)

Quality Control

14) Measure and visually inspect welded products for acceptability to American Welding Society QC-10 standards. Record discontinuities and defects and compare data to given project specifications using class-defined analysis methods. Interpret and communicate results both written and verbally. If necessary, recommend changes that will reduce the number of product defects during the manufacturing process. (TN Reading 1, 3, 4, 7; TN Writing 1, 4; TN Math N-Q, G-GMD)

15) Drawing upon multiple resources, research nondestructive testing beyond visual inspection, such as penetrant inspection, magnetic particle inspection, radiographic inspection, and ultrasonic inspection. Describe how these tests are applied as quality control techniques to prevent manufacturing defects in welding. Compare and contrast these techniques and provide specific examples for when they are most appropriately used. Cite evidence to justify the examples. Demonstrate the proper use of the magnetic particle and penetrant inspection tests on weldment samples of gas metal arc welding (GMAW), flux cored arc welding (FCAW), and gas tungsten arc welding (GTAW) processes. (TN Reading 1, 3, 6, 9; TN Writing 1, 4; TN Math N-Q, G-GMD)

16) Describe and distinguish between the guided-bend test and the free-bend test. Explain when it is most appropriate to apply each test. Demonstrate the use of each test and properly document results on a mock qualification test record form conforming to the American Welding Society (AWS) requirements. For example, perform root- and face-guided bend tests on a butt joint weld coupon. (TN Reading 3, 4, 5, 7, 9; TN Writing 2, 4; TN Math N-Q, G-GMD)

Industry Certification and Portfolio

17) Pursue the industry certification exam (e.g., American Welding Society SMAW module) using the shielded metal arc welding (SMAW) process. Demonstrate how to make multiple-pass open-butt groove welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards)

18) In preparation for industry certification exams (e.g., American Welding Society GMAW, FCAW, and GTAW modules), complete assigned team projects that incorporate the following welding processes in order to design, fabricate, evaluate, and test products made in this course. For each project, produce a technical report documenting illustrations, findings, and justifications for project solutions. Compile photographs of each project, along with technical documentation, into a portfolio of work.
   a. Using the gas metal arc welding (GMAW) process and various metal transfer methods (e.g., short-circuit, pulse-arc, and spray transfer), demonstrate how to make a complete joint penetration weld on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.
   b. Using the flux cored arc welding (FCAW) process, demonstrate how to make a complete joint penetration weld on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.
   c. Using electrodes and the gas tungsten arc welding (GTAW) process, demonstrate how to complete joint penetration welds on plain carbon steel, stainless steel, and aluminum in all feasible positions (e.g., horizontal, flat, vertical, overhead) conforming to American Welding Society quality standards.
   (TN Reading 3, 4, 5, 7, 8, 9; TN Writing 2, 4, 5, 6, 7, 8, 9; TN Math N-Q, G-GMD)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate

~~on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Manufacturing Practicum

Primary Career Cluster:	Advanced Manufacturing
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5926
Prerequisite(s):	Minimum of two credits in an Advanced Manufacturing program of study.
Credit:	1
Grade Level:	11-12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Advanced Manufacturing courses.
Programs of Study and Sequence:	This is the fourth course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Manufacturing Skills Standards Council (MSSC) Certified Production Technician (CPT)
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046),(044and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 470, 477, 501, 502, 523, 531, 537, 551, 552, 553, 554, 555, 556, 557, 575, 582, 584, 585, 596, 598, 700, 701, 705, 706, 707, 760
Required Teacher Certifications/Training:	Some endorsements require NIMS industry certification to teach this course. Please refer to the correlation of course codes for a full list.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-advanced-manufacturing

Approved January 30, 2015; Amended April 15, 2016

Course Description

Manufacturing Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous Advanced Manufacturing courses within a professional, working environment. While continuing to add to their technical skillsets, students in this course assume increasing responsibility for overseeing manufacturing processes and managing complex projects. Specifically, proficient students will be able to work in teams to plan the production of a sophisticated product; develop troubleshooting and problem solving mechanisms to ensure that projects run smoothly; analyze output and compile professional reports; and connect practicum activities to career and postsecondary opportunities. For all projects undertaken in this course, students are expected to follow the focus area in their chosen program of study (*Machining Technology, Electromechanical Technology, Mechatronics,* or *Welding*), while also refining skills previously acquired to achieve deeper levels of mastery. Upon completion of the practicum, proficient students will be prepared for postsecondary study and career advancement in their chosen focus area. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.~~*

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Machining Technology, Electromechanical Technology, Mechatronics,* and *Welding* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Advanced Manufacturing website at https://tn.gov/education/article/cte-cluster-advanced-manufacturing.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Occupational Safety and Health Administration (OSHA) guidelines, (4) American Society for Testing Materials, (4) ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment. (TN Reading 3, 4)

Advanced Manufacturing Careers

3) Research local, regional, and national companies operating in advanced manufacturing industries. Synthesize findings into a written report or oral presentation profiling several companies and the production environments in which they operate, including the specific products they manufacture, the industries in which they are used, the long- and short-term employment projections, and their overall contributions to society. For example, report on three manufacturers within the aerospace industry and describe how the products they make support the transportation sector. (TN Reading 1, 2; TN Writing 7, 9)

4) Conduct a job search within an advanced manufacturing focus area of choice, including but not limited to machining technology, electromechanical technology, mechatronics, and welding. Compare and contrast job opportunities across sample companies, and determine areas of growth. (TN Reading 9; TN Writing 4, 7)

5) Analyze the requirements and qualifications for various advanced manufacturing job postings identified in the previous standard. Gather information from multiple sources, such as sample resumes, interviews with advanced manufacturing professionals, and job boards, to determine effective strategies for realizing career goals. Create a personal resume modeled after elements based on the findings above, then complete an authentic job application as part of a career search or work-based learning experience. (TN Reading 4, 9; TN Writing 4, 7, 8)

Professional Ethics and Legal Responsibilities

6) Investigate national and international labor laws governing advanced manufacturing-related industries. Summarize the legal and professional consequences for breaking these laws, citing news media, company policies, and text from relevant legislation. For example, research Apple's stance on child and migrant labor, then compare the company's policy with independent reports on their manufacturing practices overseas. (TN Reading 1, 2, 6, 8, 9; TN Writing 1, 4, 6, 7)

7) Research the significance of patents in advanced manufacturing. Describe the process for securing a patent, and explain why patent protection is important for maintaining the integrity and quality of manufactured goods. Synthesize information from multiple sources, including the text of actual patent documents, in order to communicate the process to others. (TN Reading 2, 3, 9)

8) Research a case study involving an ethical issue related to consumer safety in the context of advanced manufacturing. Examine a variety of perspectives surrounding the issue, then develop an original analysis explaining the impact of the issue on those involved, using persuasive language and citing evidence from the research. For example, discuss the legal and financial fallout resulting from the recall of a defective automobile part; draw on news media and related coverage to describe the implications of withholding knowledge of such a defect from the public. (TN Reading 1, 2, 8; TN Writing 1, 4, 6, 7)

Advanced Process Management

9) In teams, research an industry need that can be met with a manufacturing product. If possible, meet with a potential client who could use such a product, and discuss the client's wants and needs. Research what materials, labor, equipment, and other inputs are necessary to complete production, then work as a team to develop a production plan, delegate responsibilities, and determine deadlines to meet the client's specifications. Present the plan with supporting graphics and data compiled from the research. (TN Reading 7; TN Writing 1, 2, 6)

10) Simulate the work of a plant operations manager or related position by formulating a detailed production schedule. Use diagrams, schematics, and floor plans to lay out production processes and assign sample shifts. Determine how each team member will contribute to the designated production project. (TN Reading 3, 7; TN Math G-GMD, G-MD)

11) Develop a logical decision tree to guide manufacturing processes for a range of products. Given a set of defined criteria and constraints, conduct if/then analyses to answer a variety of process-oriented questions. For example, follow a logical decision tree to determine when to employ serial, batch, or continuous manufacturing processes. (TN Reading 3, 4; TN Math F-IF)

12) Demonstrate the ability to apply statistical analysis to the evaluation of process outputs. For a given set of constraints, calculate the ideal production rate for a simulated product, then apply learnings toward original projects undertaken in this course. Using quality control methods learned in previous courses, determine criteria to maximize output and minimize product defects. (TN Reading 3; TN Math N-Q, A-CED, F-IF, S-ID)

13) Work together to assemble adequate documentation of production activities in the form of a team log, manual, or executive summary of production processes. Be able to explain to both lay and technical audiences how various aspects of the process work, including how the end product is created. Document constraints and criteria using domain-specific vocabulary and industry terminology. (TN Reading 3, 4, 5; TN Writing 2, 4, 7)

14) Execute all production plans undertaken in this course in line with resource constraints, deadlines, and all other specifications in order to meet the vision of a client or the expectations of a classroom-based project. Critique the quality of final products for their compliance with client or classroom specifications. Document product evaluations in a written format that can be easily interpreted by others. (TN Reading 3, 8; TN Writing 4, 6, 7)

Troubleshooting, Problem Solving, and Quality Control

15) Work in teams to identify, diagnose, and troubleshoot malfunctions in advanced manufacturing equipment. Apply problem solving skills learned in previous courses to determine the source of the problem(s), assess the maintenance that will be required, and develop a multistep procedure for making corrections. Conduct the required maintenance according to outlined procedures, and critique the effectiveness of the corrective action. (TN Reading 3, TN Writing 2, 8)

16) Apply quality control methods learned in previous courses to regularly test and evaluate the quality of manufactured products created in this course. Drawing on associated industry

standards, develop quality benchmarks for measuring the acceptability of the end product. Formulate criteria for identifying defects, and make recommendations for reducing the number of defects based on observations. (TN Reading 3, 4; TN Math N-Q)

17) Record accurate and repeatable measurements to specified degrees of precision, attending to appropriate units as directed. When measurements misalign, make the necessary adjustments in order to eliminate the problem. For example, if a machining part is specified to be sized within an acceptable range of nanometers, adjust the CNC code to cut the part within a more accurate margin of error. (TN Writing 4; TN Math N-Q)

Portfolio

18) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the design process, as outlined by the instructor. The following documents will reside in the student's portfolio:
    a. Personal code of ethics
    b. Career and professional development plan
    c. Resume
    d. List of responsibilities undertaken through the course
    e. Examples of visual materials developed and used during the course (such as drawings, models, presentation slides, videos, and demonstrations)
    f. Description of technology used, with examples if appropriate
    g. Periodic journal entries reflecting on tasks and activities
    h. Feedback from instructor and/or supervisor based on observations
    (TN Reading 7; TN Writing 4, 5, 6)

Communication of Project Results

19) Produce technical reports highlighting the purpose, content, and use for all advanced manufacturing and production projects undertaken in this course. Cite evidence from multiple authoritative sources in order to justify design and production decisions and maximize client satisfaction (when applicable). Incorporate supporting graphics, sketches, and data as needed to summarize the technical specifications of products generated for each project. (TN Reading 1, 2, 3, 4, 5, 7, 8, 9; TN Writing 1, 5, 6, 7, 8, 9)

20) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, flowcharts, and/or summary data generated from simulated operations and quality control analysis. Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Agriscience

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5957
Prerequisite(s):	*None*
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies one credit of laboratory science required for graduation.
Programs of Study and Sequence:	This is the first course in the *Agribusiness, Agricultural Engineering and Applied Technologies, Environmental and Natural Resources, Food Science, Horticulture Science,* and *Veterinary and Animal Science* programs of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture, Food, & Natural Resources students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	(048 and 015), (048 and 016), (048 and 017), (048 and 081), (048 and 211), (048 and 212), (048 and 213), (048 and 214), (048 and 414), (048 and 415), (048 and 416), (048 and 417), (048 and 418), (048 and 449), (150 and 015), (150 and 016), (150 and 017), (150 and 081), (150 and 151), (150 and 211), (150 and 212), (150 and 213), (150 and 214), (150 and 414), (150 and 415), (150 and 416), (150 and 417), (150 and 418), (150 and 449), (448 and 015), (448 and 016), (448 and 017), (448 and 081), (448 and 211), (448 and 212), (448 and 213), (448 and 214), (448 and 414), (448 and 415), (448 and 416), (448 and 417), (448 and 418), (448 and 449)
Required Teacher Certifications/Training:	None

Approved April 10, 2015; Amended April 15, 2016

Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Description

Agriscience is an introductory laboratory science course that prepares students for biology, subsequent science and agriculture courses, and postsecondary study. This course helps students understand the important role that agricultural science and technology plays in the twenty-first century. In addition, it serves as the first course for all programs of study in the Agriculture, Food, & Natural Resources cluster. Upon completion of this course, proficient students will be prepared for success in more advanced agriculture and science coursework. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee state standards in Anatomy and Physiology, Biology I, Biology II, Chemistry I, Chemistry II, Environmental Science, Physical Science, Physics, and Physical World Concepts, as well as the National Agriculture, Food, & Natural Resources Career Cluster Content Standards.~~ This course counts as a lab science credit toward graduation requirements.*

Program of Study Application

This course is the foundational course for all Agriculture, Food, & Natural Resources programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Agriscience Investigation and Overview

1) Synthesize research on the historical importance and purpose of agriculture and agriculture organizations, identifying major events, opportunities and technological developments influenced by agriscience theories and practices. ~~(TN Writing 8)~~

2) Identify and review general common laboratory safety procedures including but not limited to prevention and control procedures in agriscience laboratories. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3)~~

Agriculture and Society

3) Gather and analyze information from multiple authoritative sources, such as the United States Bureau of Labor Statistics, United States Department of Agriculture website and Tennessee labor data, to summarize the economic impact of the agricultural industry. Describe major career trends in Tennessee, the United States, and worldwide. ~~(TN Writing 8, 9; TN Math S-ID)~~

4) Determine how a Supervised Agricultural Experience (SAE) program functions as a method to apply concepts of the scientific investigation process (i.e. conducting an Agriscience Fair project). Compare and contrast the types of SAEs as related to their importance to the scientific investigation process. ~~(TN Reading 1, 9; TN Writing 2, 7, 9)~~

5) Conduct a research project or literature review exploring a specific social and/or political impact on the agriculture industry at the local, state, national, or international level. For example,

explore how the increase in availability of genetically modified organisms has impacted crop production and the green movement. Summarize findings in an informative essay. Revise, edit or rewrite as needed to strengthen writing. (TN Writing 2, 5, 8, 9)

Fundamentals of Environmental Systems

6) Describe the biogeochemical cycles impacting the agriculture industry by creating illustrative models and informative texts for the following:
   a. Carbon cycle
   b. Nitrogen cycle
   c. Oxygen cycle
   d. Water cycle
   (TN Reading 2; TN Writing 2, 4, 9)

7) Critique the dynamics of biomass and energy flow in ecosystems by analyzing the major components of a food chain. Analyze the structure of the relationships among the concepts of carrying capacity, species populations, and organism interactions within multiple ecosystems and natural habitats. (TN Reading 5; TN Writing 1, 9; TN Biology I 2, 3; TN Biology II 2, 3)

8) Produce an informative essay to distinguish between types of pollution and their sources, defining and applying ecology- and conservation-specific terminology. Compare and contrast important connections between pollution and its effects on environmental conditions (i.e. water, soil and air), animal populations, and plant populations. (TN Reading 4; TN Writing 2, 4, 8, 9; TN Environmental Science 6)

Fundamentals of Cell Biology

9) Compare basic plant and animal cell biology, including structure and function. Create a visual representation that identifies cellular organelles and major cell processes. (TN Reading 2, 7; TN Biology I 1; TN Biology II 1)

10) Compare and contrast the roles of proteins, carbohydrates, lipids, and nucleic acids as they relate to cell growth and cell reproduction. (TN Biology I 1; TN Biology II 1)

Fundamentals of Genetics and Heredity

11) Determine the significance of and relationships between genes, chromosomes, proteins, and hereditary traits. Analyze the role of genes in determining genetic make-up, gender, and hereditary characteristics. Using systems of equations, explain the variation and distribution of genotypes and phenotypes expressed in plants and animals. (TN Math A-CED; TN Biology I 4; TN Biology II 4)

Fundamentals of Anatomy and Physiology

12) Using graphic illustrations and supporting text, identify and describe major animal body systems (skeletal, muscular, respiratory, digestive, nervous, circulatory, respiratory, and reproductive) to establish a basic knowledge of their purpose, structure, and function. (TN A&P 1, 2, 4, 5, 6)

Chemistry of Animal Digestion

13) Classify the types of digestive systems in domestic animals, and compare and contrast their anatomical and physiological differences. Synthesize research on animal nutrition (using academic journals or publications from Tennessee Extension Service) to produce an informative narrative, including defining and applying nutrition specific terminology, to examine the stages of digestion and associated processes. (TN Reading 4, 9; TN Writing 2, 4; TN A&P 5)

14) Use the periodic table and the atomic chart to compare differences between ionic and covalent bonding as related to digestion. Demonstrate an understanding of the interdependence of the complex chemical and biological processes involved in the digestion process including, but not limited to, the following: elements, compounds, mixtures, and acids. (TN Reading 1; TN A&P 5; TN Chemistry I 1; TN Chemistry II 1, 2, 3)

15) Research the relationship between metabolism, energy, and nutrition. Evaluate life stage and activity level to determine the nutritional needs of animals. Differentiate types of rations to maximize animal performance. (TN Writing 8, 9)

Fundamentals of Plant and Soil Science

16) Apply concepts related to the basic cellular and biochemical processes in plants to demonstrate the following:
    a. Create a graphic illustration of the parts and functions of plant cells
    b. Use quantitative reasoning to balance chemical equations related to plant processes
    c. Interpret the role of physics within the cohesion-tension theory and its significance to plant life
    d. Examine the roles of photopigments and the effects of different colors of light on plant growth
    (TN Reading 7; TN Writing 9; TN Math N-Q, A-REI; TN Biology II 7)

17) Formulate a hypothesis about the correlation between plant nutrient deficiencies and soil composition. Conduct basic soil analysis to determine the chemical elements and nutritional levels available in soils essential for plant growth. Draw conclusions about the ability of soils to meet the nutritional requirements of plants. (TN Reading 3, 9; TN Writing 8; TN Biology II 7)

Reproductive Systems

18) Research and develop illustrative models that compare and contrast the reproductive structures of plants, drawing out key differences between sexual and asexual reproduction processes. (TN Biology II 7)

19) Describe the structure and function of different seed components and summarize their roles in plant reproduction and propagation. (TN Biology II 7)

20) Describe the structures and functions of the male and female animal reproductive systems. Compare and contrast the differences of the reproductive systems between small and large animal species. (TN A&P 6)

Principles of Power and Energy

21) Apply fundamental principles of physics as they relate to agricultural power and technology concepts in order to demonstrate the following:
   a. Analyze the relationship between speed, distance, and time
   b. Relate the types of simple machines to the law of machines and mechanical advantages
   c. Specify groups, sources, and forms of energy
   d. Analyze the principle of heat energy and describe the way heat travels
   e. Explain the law of conservation of energy
   f. Explain the production of energy and relate it to the invisible light spectrum
   (TN Math A-REI, A-APR; TN Physical Science 2)

Fundamentals of Electricity

22) Identify different methods by which electrical energy can be produced. Discuss the safety hazards involved in each method as well as prevention and control methods relevant to electrical power supplies. Justify the use of different precautions for the prevention or management of electrical hazards and evaluate the efficacy of the prevention measures. (TN Writing 1, 4, 7, 9; TN Physical World Concepts 4; TN Physics 5)

23) Utilize the appropriate instruments needed to calculate and measure voltage, amperage, resistance, and wattage. (TN Reading 3; TN Math N-Q; TN Physical World Concepts 4; TN Physics 5)

Fundamentals of Engines

24) Apply basic principles of thermodynamics to analyze the function of major components of gasoline and diesel fuel engines. (TN Physics 2)

25) Using quantitative reasoning and employing appropriate unit conversions, calculate horsepower and thermal efficiency in internal combustion engines by creating systems of equations that describe numerical relationships. (TN Math N-Q, A-CED)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 8, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 6, and 10 at the conclusion of the course.

- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and statistical reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN A&P: Tennessee Science: Anatomy and Physiology standards 1, 2, 4, 5, and 6 may provide additional insight and activities for educators.~~
- ~~TN Biology I: Tennessee Science: Biology I standards 1, 2, 3, and 4 may provide additional insight and activities for educators.~~
- ~~TN Biology II: Tennessee Science: Biology II standards 1, 2, 3, 4, and 7 may provide additional insight and activities for educators.~~
- ~~TN Chemistry I: Tennessee Science: Chemistry I standard 1 may provide additional insight and activities for educators.~~
- ~~TN Chemistry II: Tennessee Science: Chemistry II standards 1, 2, and 3 may provide additional insight and activities for educators.~~
- ~~TN Environmental Science: Tennessee Science: Environmental Science standard 5 may provide additional insight and activities for educators.~~
- ~~TN Physical Science: Tennessee Science: Physical Science standard 2 may provide additional insight and activities for educators.~~
- ~~TN Physical World Concepts: Tennessee Science: Physical World Concepts standard 4 may provide additional insight and activities for educators.~~
- ~~TN Physics: Tennessee Science: Physics standards 2 and 5 may provide additional insight and activities for educators.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Small Animal Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5958
Prerequisite(s):	*Agriscience* (5957)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the second course in the *Veterinary and Animal Sciences* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Small Animal Science is an intermediate course in animal science and care for students interested in learning more about becoming a veterinarian, vet tech, vet assistant, or pursuing a variety of scientific, health, or agriculture professions. This course covers anatomy and physiological systems of different groups of small animals, as well as careers, leadership, and history of the industry. Upon completion of this course, proficient students will be prepared for more advanced coursework in veterinary and animal science. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee state standards in~~

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the second course in the *Veterinary and Animal Sciences* programs of study. For more information on the benefits and requirements of implementing this program in full, visit the Agriculture, Food, and Natural Resoruces website at: https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

History of Domestication

1) Synthesize research on the history of small animal domestication to produce an informative essay, including defining and applying industry-specific terminology to classify animals in the correct taxonomy. Justify the historical uses and roles of domesticated animals, and compare historical processes of small animal domestication. (TN Reading 1, 2, 4; TN Writing 2, 4, 9)

Economic, Occupational, and Technological Implications

2) Determine the general economic impact of the small animal industry by investigating both home and business implications of small animal domestication through governmental and news publications. (TN Reading 1; TN Writing 7)

3) Explore and compare local and regional career opportunities in the small animal industry. Describe in a written or visual representation the knowledge, skills, and abilities necessary for a diverse range of careers in small animal sciences, citing specific textual evidence from local job postings and Tennessee labor data. (TN Reading 1; TN Writing 2, 9)

4) Examine specific technologies that have evolved within the small animal industry (such as, but not limited to, equipment, procedures, and healthcare) and evaluate the economic and societal implications of each. (TN Reading 1, 2, 4)

Personal and Occupational Health and Safety

5) Identify, research, and determine the significance of zoonotic diseases associated with small animals. Compare and contrast findings from multiple sources relating to a specific disease (including student's own experience, laboratory experiment, case studies, and scholarly journals). Justify the use of different methods of infection control in the prevention or management of a zoonotic disease and evaluate the efficacy of existing small animal biosecurity measures. (TN Reading 1, 5, 9)

6) Correctly identify and summarize laws and regulations that pertain to small animal health and safety in an explanatory text, citing specific textual evidence from state and national legislation. Describe health requirements and necessary documentation for small animal transportation and change of ownership. (TN Reading 1, 9; TN Writing 2, 4)

7) Review common laboratory safety procedures for tool and equipment operation in the small animal science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

8) Demonstrate in a live setting or in a presentation the ability to follow procedures precisely, attending to special cases or exceptions noted in appropriate materials, and apply them to the following areas:
   a. Animal restraint and handling
   b. Techniques for transportation
   c. Appropriate use of chemicals (such as pesticide, fungicide, disinfectants)
   Differentiate between effective methods for handling small animals and methods proven to be less effective. (TN Reading 3)

Responsible Pet Ownership

9) Research and prepare informational resources for potential pet owners (such as fact sheets, brochures, posters, or presentations) that present the benefits and responsibilities of pet ownership, including listing important factors to consider when choosing a pet, comparing and contrasting available sources for obtaining a pet, identifying and summarizing common laws governing pet ownership, and investigating the societal and economic issues that may impact pet owners. (TN Reading 1, 7, 9; TN Writing 4, 6, 8, 9)

10) Drawing from multiple sources on small animal management practices, craft an argumentative essay that contrasts the characteristics of responsible pet ownership with ownership practices that have been shown to be negligent or inappropriate. Using supporting evidence from the research to develop claim(s) and counterclaim(s), argue why certain practices fail and others succeed. Topics may include:
    a. Training and behavior management
    b. Housing, boarding, and transporting
    c. Breeding
    d. Feeding and nurturing
    e. Management of health conditions
    f. Matching of animal type/breed and owner lifestyle (including living conditions, geographic location, and number and age of family members)
    (TN Reading 1, 9; TN Writing 1, 4, 8, 9)

Animal Ethics

11) Identify the fundamental philosophies related to animal rights and animal welfare. Compare the impact of specific persons, organizations, and legislation related to animal rights and welfare of small animals, citing specific textual evidence. (TN Reading 1, 9; TN Writing 9)

12) Investigate current small animal issues by analyzing an author's purpose and assessing the extent to which the reasoning and evidence in a specific text support the author's claim. Debate specific issues by forming and supporting claims and counterclaims with specific data and evidence. Issues related to animal rights and animal welfare may include, but are not limited to:
    a. Abuse and/or neglect

   b. Illegal capture and/or trade

   c. Overpopulation

   d. Control of populations

   e. Euthanasia

   f. Exhibiting and showing

   g. Global issues in small animal ethics and their relation to local problems.
  (TN Reading 6, 7, 8, TN Writing 1, 9)

Nutrition and Digestive Systems

13) Create a visual representation to differentiate between ruminant and non-ruminant animals, comparing and contrasting their anatomical and physiological differences. (TN Reading 7, TN A&P 5)

14) Using information from scholarly journals or Tennessee Extension Service, research nutrient requirements of the diets of small animals and organize these into various nutrient groups. Interpret feed labeling and evaluate factors such as life stage and activity level to determine the nutritional needs and then recommend balance rations for small animals, justifying recommendations with evidence from the text. (TN Reading 1, 7; TN Writing 2, 4; TN A&P 6)

15) Distinguish among the symptoms of nutritional diseases relevant to small animals and recommend the appropriate control procedures, expressed in writing. (TN Reading 7, 9; TN Writing 2)

Genetics and Reproduction

16) Research and develop illustrative models of the major components of male and female reproductive systems in small animals and prepare a short narrative to distinguish the function of reproductive organs, endocrine glands, and hormones. Produce an explanatory essay summarizing the physiological changes that occur during reproductive phases, including the estrus cycle, fertilization, gestation, parturition and lactation. (TN Reading 7; TN Writing 2, 4; TN A&P 6)

17) Using graphic representations and descriptive text, explain how the fundamental principles of genetics, such as but not limited to concepts of inheritance and gene transfer, apply to the study of small animals. (TN Biology I 4, TN Biology II 4)

Fundamental Care and Health of Dogs and Cats

18) Synthesize research on the historical importance of dogs and cats, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that differentiates between the defining characteristics of common dog and common cat breeds. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:

   a. Precisely follow effective grooming procedures and techniques to maintain healthy skin, coat, nails, eyes, and ears

b. Design appropriate facilities based on assessment of needs and present plans in a visual format
c. Identify appropriate owner/handler responses to behaviors and instincts to ensure safety of both individual and small animal in a variety of situations
d. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
e. Using quantitative reasoning and appropriate units, calculate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs
f. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies
g. Research common diseases and parasites and their effects on the health of dogs and cats, and draw evidence from relevant medical literature to recommend the best prevention or control measures.
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q)

Fundamental Care and Health of Rabbits, Guinea Pigs, Chinchillas, and Rodents

19) Synthesize research on the historical importance of rabbits, guinea pigs, chinchillas, and rodents, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that differentiates between their defining characteristics. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:
a. Precisely follow effective grooming procedures and techniques to maintain healthy skin, coat, nails, eyes, and ears
b. Design appropriate facilities based on assessment of needs and present plans in a visual format
c. Identify appropriate owner/handler responses to behaviors and instincts to ensure safety of both individual and small animal in a variety of situations
d. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
e. Using quantitative reasoning and appropriate units, calculate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs
f. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies
g. Research common diseases and parasites and their effects on the health of rabbits, guinea pigs, chinchillas, and rodents, and draw evidence from the most recent medical literature to recommend the best prevention or control measures.
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q)

Fundamental Care and Health of Avians, Fish, Amphibians, and Reptiles

20) Synthesize research on the historical importance of avians, fish, amphibians, and reptiles, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that differentiates between their defining characteristics. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:

a. Precisely follow effective grooming procedures and techniques for applicable species
b. Design appropriate facilities based on assessment of needs and present plans in a visual format
c. Identify appropriate owner/handler responses to behaviors and instincts to ensure safety of both individual and small animal in a variety of situations
d. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
e. Using quantitative reasoning and appropriate units, calculate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs.
f. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies
g. Research common diseases and parasites and their effects on the health of birds, fish, amphibians, and reptiles, and draw evidence from the most recent medical literature to recommend the best prevention or control measures.
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity (pages 58-83).
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- TN Biology I: Tennessee Science: Biology I, standard 4.
- TN Biology II: Tennessee Science: Biology II, standard 4
- TN A&P: Tennessee Science: Anatomy and Physiology, standards 5 and 6.

- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards AS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Large Animal Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6116
Prerequisite(s):	*Small Animal Science* (5958)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the third course in the *Veterinary and Animal Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Beef Quality Assurance (BQA); Pork Quality Assurance (PQA)
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Large Animal Science is an applied course in veterinary and animal science for students interested in learning more about becoming a veterinarian, vet tech, vet assistant, or pursuing a variety of scientific, health, or agriculture professions. This course covers anatomy and physiological systems of different groups of large animals, as well as careers, leadership, and history of the industry. Upon completion of this course, proficient students will be prepared for success in the level-four *Veterinary Science* course and further postsecondary training. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, as well as Tennessee state standards in

Approved April 10, 2015; Amended April 15, 2016

~~Anatomy and Physiology and National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*~~

Program of Study Application

This is the third course in the *Veterinary and Animal Sciences* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at http://www.tn.gov/education/cte/AgricultureFoodNaturalResources.shtml.

Course Standards

History of Domestication

1) Synthesize research on the history of large animal domestication to produce an informative essay, including defining and applying industry-specific terminology to classify animals in the correct taxonomy. Justify the historical uses and roles of domesticated animals, and compare historical processes of large animal domestication. ~~(TN Reading 1, 4, 9; TN Writing 2, 4, 9)~~

Economic, Occupational and Technological Implications

2) Determine the general economic impact of the large animal industry by investigating both recreational and business implications of large animal domestication through governmental and news publications. Develop a summary including both graphical representations and descriptive text to summarize findings. ~~(TN Reading 1; TN Writing 7)~~

3) Explore and compare local and regional career opportunities in the large animal industry and evaluate labor data to predict the employment outlook. Describe in a written or visual representation the knowledge, skills, and abilities necessary for a diverse range of careers in large animal sciences citing specific textual evidence from local job postings and Tennessee labor data. ~~(TN Reading 1, 2; TN Writing 2, 9)~~

4) Accurately maintain an activity recordkeeping system and apply proper financial recordkeeping skills as they relate to a large animal science supervised agricultural experience (SAE) program. Demonstrate the ability to summarize records and reports by completing SAE and related applications. ~~(TN Reading 9; TN Writing 2, 9)~~

5) Examine specific technologies that have evolved within the large animal industry (such as, but not limited to equipment, housing, procedures, and healthcare) and evaluate the economic and societal implications of each. ~~(TN Reading 1, 2, 4)~~

Personal and Occupational Health and Safety

6) Identify, research, and determine the significance of zoonotic diseases associated with large animals. Compare and contrast findings from multiple credible sources relating to a specific disease (including student's own experience or laboratory experiment, case studies, and scholarly journals). Justify the use of different methods of infection control in the prevention or management of a zoonotic disease and evaluate the efficacy of existing large animal biosecurity measures. ~~(TN Reading 1, 5, 9)~~

7) Correctly identify and summarize laws and regulations that pertain to large animal health and safety in an explanatory text, citing specific textual evidence from state and national legislation. Describe health requirements and necessary documentation for large animal transportation and change of ownership. (TN Reading 1, 9; TN Writing 2, 4)

8) Review common laboratory safety procedures for tool and equipment operation in the large animal laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

9) Demonstrate in a live setting or in a presentation the ability to follow procedures precisely, attending to special cases or exceptions noted in appropriate materials, and apply them to the following areas:
    a. Animal restraint and handling
    b. Techniques for transportation
    c. Appropriate use of chemicals (such as pesticide, fungicide, disinfectants)
Differentiate between effective methods for handling large animals and methods proven to be less effective. (TN Reading 3)

Animal Ethics

10) Identify the fundamental philosophies related to animal rights and animal welfare. Compare the impact of specific persons, organizations, and legislation related to animal rights and welfare of large animals. (TN Reading 1, 9; TN Writing 9)

11) Investigate current large animal issues by analyzing an author's purpose and assessing the extent to which the reasoning and evidence in a specific text support the author's claim. Debate specific issues by forming and supporting claims and counterclaims with specific data and evidence. Issues related to animal rights and animal welfare may include, but are not limited to:
    a. Abuse and/or neglect
    b. Environmental implications
    c. Consumer product implications
    d. Exhibiting and showing
    e. Global issues in large animal ethics and their relation to local problems
(TN Reading 6, 8, 9; TN Writing 1)

Nutrition and Digestive Systems

12) Create a visual representation to differentiate between ruminant and non-ruminant animals and monogastric and polygastric animals, comparing and contrasting their anatomical and physiological differences. Explain the relationships of digestive system types to the ability of an animal to digest and absorb different classes of feed. (TN Reading 7, TN A&P 5)

13) Using information from scholarly journals or Tennessee Extension Service, research nutrient requirements of the diets of large animals and organize these into various nutrient groups. Differentiate between roughages and concentrates and their nutritional values. (TN Reading 7; TN Writing 9)

14) Interpret feed labeling and evaluate factors such as life stage and activity level to determine the nutritional needs and then recommend balance rations for each large animal species, justifying recommendations with evidence from the text. (TN Reading 1, 3, 7; TN Writing 1, 4, 9)

15) Diagnose the symptoms of nutritional diseases relevant to large animals and recommend the appropriate control procedures, citing specific evidence to support recommendations. (TN Reading 7; TN Writing 1, 7, 8, 9)

Genetics and Reproduction

16) Research and develop illustrative models of the major components of male and female reproductive systems in large animals and prepare a short narrative to distinguish the function of reproductive organs, endocrine glands, and hormones. Produce an explanatory essay comparing the physiological changes that occur across different species during reproductive phases, including the estrus cycle, fertilization, gestation, parturition and lactation. (TN Reading 7, 9; TN Writing 2, 4; TN A&P 6)

17) Using graphical representations and descriptive text, explain how the roles of heritability, selection intensity, generation interval, and other advanced principles of genetics (such as DNA testing for disorders) apply to predict gene and trait transfer in large animal species. Principles include but are not limited to:
    a. Economically important traits in production animals (i.e. artificial reproduction methods)
    b. Interpretation and utilization of animal performance records (i.e. Expected Progeny Difference [EPD])
    c. Hybrid vigor
    (TN Reading 1, 4, 7, 9; TN Writing 2, 4, 7, 9; TN Biology I 4; TN Biology II 4)

Fundamental Care and Health of Horses

18) Synthesize research on the historical importance of horses, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that formulates comparisons among different horse breeds and hybrids. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:
    a. Design appropriate facilities based on assessment of needs and present plans in a visual format
    b. Compare appropriate owner/handler responses to behaviors and instincts to ensure safety of both handler and animal in a variety of situations
    c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence (TN Reading 1)
    d. Using quantitative reasoning and appropriate units, calculate appropriate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
    e. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies (TN Reading 2, 7)

f. Research common diseases and parasites and their effects on the health of horses, and draw evidence from the most recent medical literature to recommend the best prevention or control measures.
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q, A-CED)

Fundamental Care and Health of Cattle

19) Synthesize research on the historical importance of cattle, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that formulates comparisons among different cattle breeds. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:
   a. Design appropriate facilities based on assessment of needs and present plans in a visual format
   b. Compare appropriate owner/handler responses to behaviors and instincts to ensure safety of both handler and animal in a variety of situations
   c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
   d. Using quantitative reasoning and appropriate units, calculate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
   e. Illustrate the reproductive cycle graphically, summarize available breeding method, and current reproductive technologies
   f. Research common diseases and parasites and their effects on the health of cattle, and draw evidence from the most recent medical literature to recommend the best prevention or control measures
   g. Evaluate the economic implications of livestock management practices (such as dehorning)
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q, A-CED)

Fundamental Care and Health of Sheep and Goats

20) Synthesize research on the historical importance of sheep and goats, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that formulates comparisons among different sheep and goat breeds. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:
   a. Design appropriate facilities based on assessment of needs and present plans in a visual format
   b. Compare appropriate owner/handler responses to behaviors and instincts to ensure safety of both handler and animal in a variety of situations
   c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
   d. Using quantitative reasoning and appropriate units, calculate appropriate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
   e. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies

f.　Research common diseases and parasites and their effects on the health of sheep and goats, and draw evidence from the most recent medical literature to recommend the best prevention or control measures
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q, A-CED)

Fundamental Care and Health of Swine

21) Synthesize research on the historical importance of swine, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that formulates comparisons among different swine breeds. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:
　　a.　Design appropriate facilities based on assessment of needs and present plans in a visual format
　　b.　Compare appropriate owner/handler responses to behaviors and instincts to ensure safety of both handler and animal in a variety of situations
　　c.　Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
　　d.　Using quantitative reasoning and appropriate units, calculate appropriate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
　　e.　Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies
　　f.　Research common diseases and parasites and their effects on the health of swine, and draw evidence from the most recent medical literature to recommend the best prevention or control measures
(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q, A-CED)

Fundamental Care and Health of Poultry

22) Synthesize research on the historical importance of poultry, noting major economic, social, and medical advances impacting domestication. Produce an informational essay or model (such as a timeline, graphical illustration, or presentation) that formulates comparisons among different poultry breeds. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:
　　a.　Design appropriate facilities based on assessment of needs and present plans in a visual format
　　b.　Compare appropriate owner/handler responses to behaviors and instincts to ensure safety of both handler and bird in a variety of situations
　　c.　Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
　　d.　Using quantitative reasoning and appropriate units, calculate appropriate rations based on bird characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
　　e.　Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies

  f. Research common diseases and parasites and their effects on the health of poultry, and draw evidence from the most recent medical literature to recommend the best prevention or control measures

  ~~(TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 7, 8, 9; TN Math N-Q, A-CED)~~

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and algebraic reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN A&P: Tennessee Science: Anatomy and Physiology standards 5 and 6 may provide additional insight and activities for educators.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards AS and CS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Veterinary Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5961
Prerequisite(s):	*Large Animal Science* (6116)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses. In addition, this course satisfies one credit of laboratory science required for graduation.
Programs of Study and Sequence:	This is the fourth and final course in the *Veterinary and Animal Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit and dual enrollment opportunities with specific community colleges and universities, including University of Tennessee Martin, Tennessee Tech University, and Volunteer State Community College.
Teacher Endorsement(s):	(048 and 015), (048 and 016), (048 and 017), (048 and 081), (048 and 211), (048 and 212), (048 and 213), (048 and 214), (048 and 414), (048 and 415), (048 and 416), (048 and 417), (048 and 418), (048 and 449), (150 and 015), (150 and 016), (150 and 017), (150 and 081), (150 and 151), (150 and 211), (150 and 212), (150 and 213), (150 and 214), (150 and 414), (150 and 415), (150 and 416), (150 and 417), (150 and 418), (150 and 449), (448 and 015), (448 and 016), (448 and 017), (448 and 081), (448 and 211), (448 and 212), (448 and 213), (448 and 214), (448 and 414), (448 and 415), (448 and 416), (448 and 417), (448 and 418), (448 and 449)
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Approved April 10, 2015; Amended April 15, 2016

Course Description

Veterinary Science is an advanced course in animal science and care for students interested in learning more about becoming a veterinarian, vet tech, vet assistant, or pursuing a variety of scientific, health, or agriculture professions. This course covers principles of health and disease, basic animal care and nursing, clinical and laboratory procedures, and additional industry-related career and leadership knowledge and skills. Upon completion of this course, students will be able to pursue advanced study of veterinary science at a postsecondary institution. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee state standards in Anatomy and Physiology, Biology I, and Biology II, as well as National Agriculture, Food and Natural Resources Career Cluster Content Standards.~~*

Program of Study Application

This is the fourth and final course in *Veterinary and Animal Sciences* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Economic, Occupational, and Technological Implications

1) Explore and compare local and regional career opportunities in the veterinary science industry using information from local job postings and Tennessee labor data. Describe in a written or visual representation the knowledge, skills, and abilities necessary for a selected occupation in veterinary science. ~~(TN Reading 1, 2; TN Writing 4)~~

2) Examine specific technologies that have evolved within the veterinary science industry including but not limited to advances in equipment, procedures, and healthcare, and evaluate the economic and societal implications of each. Explain in an informative essay how these advances have impacted the veterinary science industry. ~~(TN Writing 2, 4, 7, 8, 9)~~

Personal and Occupational Health and Safety

3) Compare and contrast the safety hazards associated with clinical and field settings. Review safety hazard case studies and recommend research-based practices to prevent the safety hazard in the future. ~~(TN Reading 1, 9)~~

4) Review common laboratory safety procedures for tool and equipment operation in the veterinary science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. ~~(TN Reading 3)~~

5) Demonstrate in a live setting or in a presentation the ability to follow procedures precisely for the following areas:
    a. Animal restraint and handling in clinical or field settings

b. Sanitation, disinfection, and sterilization procedures to prevent transfer of zoonotic diseases
c. Material safety data sheets (MSDS) interpretation
(TN Reading 3)

Veterinary Law and Ethics

6) Gather and compare information from a variety of authoritative sources (such as professional associations or non-profit organizations) on the philosophical, social, moral, and ethical issues encountered in the veterinary profession. Debate their implications for practitioners of veterinary science by developing claim(s) and counterclaim(s) supported by reasoning and evidence from research. (TN Reading 1; TN Writing 1, 4, 7, 8, 9)

7) Citing specific textual evidence from legislation and news media, summarize local, state, and federal laws that regulate policies and procedures in veterinary medicine pertaining to:
   a. Animal rights and welfare
   b. Professional licensing
   c. Liability of veterinary staff
   d. U.S. Food and Drug Administration (FDA), U.S. Department of Agriculture (USDA), and U.S. Environmental Protection Agency (EPA) regulations for veterinary drugs and biologicals
   e. Occupational Safety and Health Administration (OSHA) regulations for workplace safety
   (TN Reading 1, 2; TN Writing 7, 9)

Clinical Anatomy and Physiology

8) Identify common clinical terminology, abbreviations, and symbols relating to the diagnosis, pathology, and treatment of animals. (TN Reading 4)

9) Recognize various states of cellular homeostasis to identify infections, diseases, and mutations. (TN Biology I 1; TN Biology II 1)

10) Review fundamental concepts pertaining to tissue and organ systems by comparing and contrasting the structure and function of different tissue types, including epithelial, connective, muscle, and nervous tissues. Summarize in written or presentation format how cellular differentiation allows for specialized tissue development. (TN Writing 2, 4; TN Biology I 1; TN Biology II 1)

11) Identify and research the major body systems, including skeletal, muscular, respiratory, digestive, nervous, integumentary, urinary, and reproductive system. Develop models to compare and contrast between different species of small and large domesticated animals. (TN Reading 7; TN A&P 1, 2, 5, 6)

Clinical Nutrition

12) Perform nutritional assessment techniques, including body condition scoring and life stage to determine the nutritional status of animals. Apply this information to recommend balanced

rations, providing written and oral justification to support recommendations. (TN Reading 1, 3, 9; TN Writing 2)

13) Research the relationships of diseases and disorders to digestion, absorption, and metabolic processes using case studies, instructional materials, and scholarly journals. Assess the impact of various diseases and disorders on the maintenance of optimum nutrition levels in the body. (TN Reading 1, 2, 5, 9)

Clinical Procedures

14) Correctly identify and describe the function of common equipment used in the clinical area of a veterinary practice, including but not limited to examination tools, radiology equipment, ultrasound equipment, surgical equipment and testing equipment. Develop a checklist including safe use and maintenance for specific equipment. (TN Reading 2, 9; TN Writing 4, 8, 9)

15) Demonstrate, in a live setting or in a presentation, physical examination procedures in the following areas:
    a. Identification of exam purpose, importance, and routine tasks
    b. Completion of new client health history report
    c. Identification and evaluation of factors affecting the physiological state of animals
    d. Identification of characteristics and signs of healthy animals
    e. Demonstration of procedures to accurately obtain and record vital signs
    f. Identification and evaluation of effects of age, stress, and environmental factors on vital signs
    (TN Reading 3)

16) Identify and recommend the optimum timeline for administering different types of vaccines suitable for different species. Demonstrate, in a live setting or in a presentation, the ability to:
    a. Identify injection methods
    b. Identify appropriate anatomical injection sites
    c. Administer the injection, including the selection of appropriate equipment
    (TN Reading 3, 7, 9; TN Writing 2)

17) Explain the importance of contamination prevention as related to the veterinary industry. Demonstrate, in a live setting or in a presentation, the ability to explain and follow contamination control procedures relating to the following areas:
    a. Principles of sanitation, disinfection, antiseptics, and sterilization
    b. Exam room care and sanitation procedures
    c. Classification of sterilants, antiseptics, disinfectants, and their appropriate applications
    d. Hazardous waste management
    e. Proper techniques to fill a syringe for a prescribed dosage
    (TN Reading 1, 3, 7, 9)

Animal Nursing

18) Design a plan of care by interpreting patient records and treatment plans, and perform basic nursing and patient monitoring tasks. (TN Writing 2, 4, 9)

19) Outline basic first aid, wound care, and bandaging procedures and compare the different procedures in relation to small and large animals. Demonstrate, in a live setting or in a presentation, the ability to follow these procedures precisely, while distinguishing between small and large animals for the following areas:
   a. Canine cardiopulmonary resuscitation (CPR) procedures
   b. Assessment and care of common physical injuries such as cuts, abrasions, and contusions
   c. Wound therapies at different phases of healing
   d. Types and purposes of bandages, splints, slings, and casts, and indications for use
   e. Techniques for application and removal of bandages
   f. Caring of animals during the birthing process
   (TN Reading 3)

20) Research and explain laws and regulations related to the administration of prescription and over-the-counter medication within the veterinary industry to develop a customer fact sheet for common medicines, citing specific text from legislation. Demonstrate, in a live setting or in a presentation, the ability to follow medication administration procedures precisely, including:
   a. Identification of common medications and their required storage, handling, and disposal
   b. Demonstration of administration techniques for topical and oral medications
   c. Interpretation of medication label and packaging information
   d. Calculate proper dosages of medications based upon label directions
   (TN Reading 2, 3; TN Writing 2, 4, 7, 9)

Laboratory Procedures

21) Compare and contrast appropriate laboratory quality control procedures such as the proper collection, preparation, handling, and storage of biological samples, and describe their effects on obtaining accurate data from laboratory procedures. (TN Reading 8, 9; TN Writing 2, 7, 9)

22) Develop a procedural check sheet to aid in conducting veterinary clinical hematology procedures such as complete blood count (CBC). Using the check sheet, demonstrate, in a live setting or in a presentation, the ability to follow clinical hematology procedures precisely in relation to the following areas:
   a. Sample collection, preparation, and storage
   b. Microscopic examination to identify blood cells
   c. Interpretation of normal and abnormal results
   (TN Reading 3, 7, 8)

23) Explain and justify the need for conducting urinalysis and fecal analysis as related to animal health. Outline procedures for conducting clinical urinalysis to include the following:
   a. Sample collection, preparation, and storage
   b. Physical, chemical, and microscopic examination procedures
   c. Interpretation of normal and abnormal results
   (TN Reading 3)

Principles of Disease

24) Compare and contrast the role of the USDA, state veterinarians, state animal disease laws, and diagnostic labs in disease prevention and control. Explain the classification of diseases and disease processes, and identify causative factors and agents of disease in a graphical illustration or written analysis. (TN Reading 7, 9; TN Writing 2, 9)

25) Explain how diseases affect the body and differentiate between clinical signs and symptoms of disease. Identify and describe the differences between clinical signs and symptoms of proper health and poor health. (TN Writing 2, 7, 9; TN Writing 2, 4, 7, 9)

26) Identify symptoms of common animal diseases and their causative agents, and summarize methods of prevention, treatment, and control by drawing evidence from informational texts or recent medical literature. (TN Reading 2, 7, 8, 9; TN Writing 2, 7, 9)

27) Describe the clinical signs of an animal with a parasite infection. Compare and contrast the symptoms of common internal and external parasite infections and summarize methods of prevention, treatment, and control between small and large animals. (TN Writing 2, 9)

Clinic Management

28) Demonstrate effective oral and written communication skills needed in clinical settings, including but not limited to client greeting, telephone answering, appointment scheduling and management, and admission and discharge procedures. Outline the procedures for euthanasia and post mortem customer care and role-play appropriate grief counseling services for clients. (TN Reading 2, 7, 9; TN Writing 2, 4)

29) Identify the types of medical records required in veterinary practices. Explain, justify, and demonstrate correct procedures for the completion and filing of veterinary records and related documentation in a professional and legal manner. (TN Reading 1, 7, 9; TN Writing 2, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6 and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.

- SAE: [Supervised Agricultural Experience](): All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN A&P: Tennessee Science: Anatomy and Physiology standards 1, 2, 5, 6.~~
- ~~TN Biology I: Tennessee Science: Biology I standard 1.~~
- ~~TN Biology II: Tennessee Science: Biology II standard 1.~~
- AFNR: [National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards](): Students engaged in activities outlined above should be able to demonstrate fluency in Standards AS.01, AS.02, AS.03, AS.04, and AS.06 at the conclusion of the course.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning]()
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Agricultural Mechanics

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5944
Prerequisite(s):	*Agriscience* (5957)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the second course in the *Agricultural Engineering and Applied Technologies* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing an opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	No
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Principles of Agricultural Mechanics is an intermediate course introducing students to basic skills and knowledge in construction and land management for both rural and urban environments. This course covers topics including project management, basic engine and motor mechanics, land surveying, irrigation and drainage, agricultural structures, and basic metalworking techniques. Upon completion of this course, proficient students will be prepared for more advanced coursework in agricultural

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mechanics. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, and National Agriculture, Food, and Natural Resources Career Cluster Content Standards.*~~

Program of Study Application

This is the second course in the *Agricultural Engineering and Applied Technologies* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at
https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Standards

Safety

1) Identify the benefits of knowing and applying basic safety procedures in both an agricultural laboratory and workplace. Interpret current Occupational Safety and Health Administration (OSHA) guidelines to conduct a compliance review of the agricultural laboratory, including a written summary justifying the findings with recommendations for improving the safety of working conditions. ~~(TN Reading 1, 2; TN Writing 1, 4, 7, 9)~~

2) Review common laboratory safety procedures for tool and equipment operation in the agricultural mechanics laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. ~~(TN Reading 3)~~

Project Management

3) Outline the basic principles and procedures of effective project planning. Create and present a project plan for an agricultural mechanics project or a supervised agricultural experience program related to agriculture mechanics. ~~(TN Reading 2; TN Writing 4)~~

4) Using industry-specific terminology, identify components for preparing a budget and cost estimate. Develop a budget using a scaled drawing or blueprint to construct or repair an agriculture mechanics project. ~~(TN Reading 1, 7; TN Writing 8; TN Math N-Q, s SSE)~~

Engine and Motor Mechanics

5) Compare and contrast the chief features, functions, and applications of two-cycle engines, four-cycle engines, and electric motors. Citing technical references, recommend a maintenance schedule specific to the working environment (such as indoor/outdoor conditions, exposure to heat or cold) of the engine and/or motor. Conduct the appropriate maintenance with adherence to specifications outlined in the schedule. ~~(TN Reading 1, 2; TN Writing 2, 4, 7, 8, 9)~~

6) Identify and differentiate between the different types of fuel and power sources used in conjunction with engines and motors. Recommend the types and sizes of engines/motors best suited for a range of applications. Provide a written justification, citing specific textual evidence,

to support the recommendation. (TN Writing 1, 7, 9)

Surveying

7) Using topographical maps and appropriate mathematical equations, determine the acreage of a specific plot of land. Document and defend the methods used to arrive at the result, annotating calculations and field notes in a manner easily retrieved by other readers. (TN Reading 3, 4; TN Writing 4, 7; TN Math N-Q, G-CO, G-MG)

8) Apply precision surveying processes and geographic information system (GIS) technology to calculate the acreage of a specific plot of property. Using field notes and digital data (such as GIS overlays), develop a written survey report of the designated plot to include, at minimum, measurements, degrees, markers, and other notable geographic parameters. (TN Reading 3, 7; TN Writing 2, 7, 9; TN Math N-Q, G-CO, G-MG)

Irrigation and Drainage

9) Analyze the interrelationships among plants, water, air, and soil to maximize the health and productivity of agricultural crops. Calculate the permeability rate, available water holding capacity, pH levels, and nutrient levels for a specific soil type. (TN Reading 4; TN Math N-Q, F-BF)

10) Apply physics concepts governing various pumping systems and delivery options to achieve the optimum irrigation and drainage required for row crop, greenhouse, and nursery operations in various soil-plant-climate combinations. Develop irrigation schedules to satisfy the design daily irrigation requirements (DDIR) for specific crops, citing specific textual evidence. (TN Reading 1; TN Writing 4; TN Math N-Q, A-CED, F-BF)

11) Compare and contrast irrigation methods for row crops, attending to such factors as water conservation, efficiency, and cost. Investigate and document findings on the effectiveness and efficiency of a surface irrigation versus a drip irrigation method, developing claim(s) and counterclaim(s) for scenarios in which each method would be most applicable. (TN Reading 1; Writing 1, 7, 9; TN Math N-Q, F-IF)

Agricultural Structures

12) Interpret plans and working drawings to select appropriate building materials for a given agricultural structure. Using correct units and measurements, draft a written bill of materials enumerating the quantities of each selection, including but not limited to concrete, masonry, wood, metal, and composite materials. (TN Reading 3, 4, 5; TN Writing 2, 4, 9; TN Math N-Q, A-REI, G-MG)

13) Applying construction principles pertaining to wood, concrete, metal, masonry, plumbing and electricity construct or repair an agricultural structure according to prescribed working plans. (TN Reading 3, 7; TN Math N-Q, G-MG)

Agricultural Metalworking

14) Compare and contrast the physical and chemical properties of arc welding, metal inert gas (MIG) welding, gas welding, soldering, and brazing. Demonstrate the ability to precisely follow operational and safety procedures for each fusion process across various applications. ~~(TN Reading 3)~~

15) Classify the physical and chemical properties associated with various metal-cutting methods. Demonstrate adherence to operational and safety procedures for using oxy-fuel or plasma in applications involving mild steel, copper, sheet metal, and cast iron. ~~(TN Reading 3)~~

16) Select and demonstrate the best method to construct, connect, or repair metallic and non-metallic materials for a variety of agricultural applications, including but not limited to plumbing, sheeting, and equipment. ~~(TN Reading 3)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 6, 9, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards. Students engaged in activities outlined above should be able to demonstrate fluency in Standards in CS, PST, ABS, NRS, ESS, and PS systems at the conclusion of the course.

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Agricultural Power and Equipment

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5945
Prerequisite(s):	*Principles of Agricultural Mechanics* (5944)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Programs of Study and Sequence:	This is the third course in the *Agricultural Engineering and Applied Technologies* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Agricultural Power and Equipment is an applied course in agricultural engineering with special emphasis on laboratory activities involving small engines, tractors, and agricultural equipment. The standards in this course address navigation, maintenance, repair, and overhaul of electrical motors, hydraulic systems, and fuel-powered engines as well as exploration of a wide range of careers in agricultural mechanics. Upon completion of this course, proficient students will be able to pursue advanced training in agricultural engineering and related fields at a postsecondary institution. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects,

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Program of Study Application

This is the third course in the *Agricultural Engineering and Applied Technologies* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food and Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Occupational Awareness & Safety

1) Consult industry manuals to ascertain the specific safety prevention and control standards governing the agricultural engineering industry. Demonstrate adherence to recognized standards, and apply occupational safety concepts across all coursework, such as but not limited to procedures surrounding general safety, personal safety (such as the use of personal protective equipment), lifting, transporting, alerting, and reporting. (TN Reading 3)

2) Review common laboratory safety procedures for tool and equipment operation in the agricultural power and equipment laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

3) Use local news media, organizational websites, and real-time labor market information to investigate occupations in agricultural power and equipment. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. (TN Reading 2, 9; TN Writing 4, 7, 9)

Career Awareness

4) Gather and analyze information from multiple authoritative sources such as the United States Bureau of Labor Statistics (BLS) to develop a written projection of the occupational trends related to agriculture power and equipment. Supplement the narrative with relevant and properly cited charts, graphs, and other visual representations. (TN Reading 1, 9; TN Writing 2, 9)

5) Investigate opportunities to expand and diversify a Supervised Agricultural Experience (SAE) program as related to agriculture power and equipment. Accurately maintain an activity recordkeeping system and apply proper financial recordkeeping skills to summarize records by completing SAE related applications and reports. (TN Reading 9; TN Writing 2)

Engine and Motor Mechanics

6) Compare and contrast the first and second laws of thermodynamics as applied to the study of combustion engines. Analyze the theory of operation and efficiency of internal combustion engines with regard to fuels, engine displacement, ignition, lubrication, and cooling. (TN Reading 1)

7) Evaluate and optimize engine performance under load and no-load operation, considering the effects of air temperature, humidity, fuel quality, and engine tuning. (TN Reading 4; TN Math F-IF, S-ID)

8) Citing technical data and documentation of prior work, develop a written recommendation outlining a specific task or procedure for a given engine or motor (such as using a three-phase 5 hp electric motor in order to drive a 125-foot conveyor belt for lifting grain to a 60-foot silo). (TN Reading 1; TN Writing 1, 4; TN Math N-Q, A-SSE, F-IF, F-LE)

9) Demonstrate the ability to troubleshoot single-cylinder engines and electric motors. Create a written estimate of repairs, including parts, labor, time, and total cost. (TN Reading 1, 3, 4; TN Writing 2, 4)

Agriculture Machinery

10) Recommend the appropriate machinery for a given agricultural application by matching the mechanical need to the scale and magnitude of the specific task. Using clear and coherent writing, justify the recommendation based on availability of parts, operational costs, maintenance, safety, and total cost. For example, recommend the appropriate tractor for a specified task based on power ratings, engine and transmission systems, hydraulic capabilities, hitching, and ballasting. (TN Reading 1, 3, 4, 7, 9; TN Writing 1, 2, 4)

11) Research the basic types of fuel and lubricants; differentiate their chief components, characteristics and applications as related to agricultural equipment in an explanatory essay. (TN Writing 2, 4, 7, 8, 9)

12) Demonstrate the ability to maintain, troubleshoot, and repair agricultural equipment and create a written estimate of repairs including itemization of parts, labor, time, and total cost. (TN Reading 3; TN Writing 2, 4; TN Math N-Q))

13) Compose an informational text comparing and contrasting the types and functions of precision and advanced technologies (such as geographic information systems [GIS], global positioning systems [GPS], and unmanned aerial vehicles [UAV]) available to the agriculture industry, citing technical data where appropriate. (TN Reading 1, 9; TN Writing 2, 4, 8, 9)

14) Demonstrate in a live setting or in a presentation the ability to safely operate agriculture equipment, including precision-operated equipment if available. (TN Reading 3)

Hydraulics

15) Write an explanatory text to summarize the components and operational theory of a basic hydraulic system used in an agriculture setting. (TN Writing 2, 7, 9)

16) Design a hydraulic system to perform a specific task, applying the principles of fluid kinematics and hydrostatics to outline how the system functions. The design should include specifications for pumps, pipes, and flow rates. (TN Writing 2, 4; TN Math G-GMD)

17) Troubleshoot and repair hydraulic power and control systems used in agricultural equipment such as piston-driven lifts and compression devices (such as shears, crushers). Document the parts and labor involved and draft a repair bill for suitable compensation. ~~(TN Reading 3; TN Writing 2, 8, 9; TN Math N-Q)~~

Navigation and Surveying

18) Explain how agricultural enterprises employ geographic information systems (GIS) and global positioning systems (GPS) in their work, including GIS software, GPS receivers, data acquisition, and spatial analysis of data. Debate the legal, ethical, and economic implications of the use of these emerging technologies with regard to maximizing the efficiency and efficacy of agricultural processes, citing specific textual evidence from case studies and news media. ~~(TN Reading 1, 9; TN Writing 2, 8, 9)~~

19) Correctly and safely use precision surveying instruments to make measurements of large acreages. Compile a written survey report for use by a lay reader, supplementing the narrative with charts, graphs, and other visual representations to aid comprehension. ~~(TN Reading 3; TN Writing 2, 7; TN Math N-Q)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, geometric, functional, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~

- SAE: [Supervised Agricultural Experience](#): All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: [National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards](#). Students engaged in activities outlined above should be able to demonstrate fluency in Standards in CS, PST, ABS, NRS, PS, and ESS at the conclusion of the course.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Agricultural and Biosystems Engineering

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5963
Prerequisite(s):	*Agricultural Power and Equipment* (5945)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Agricultural Engineering and Applied Technologies* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities with specific universities, including Tennessee Technological University (TTU).
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Description

Agricultural and Biosystems Engineering is an applied course that prepares students for further study or careers in engineering, environmental science, agricultural design and research, and agricultural mechanics. Special emphasis is given to the many modern applications of geographic information systems (GIS) and global positioning systems (GPS) to achieve various agricultural goals. Upon completion of this course, proficient students will be able to pursue advanced training in agricultural engineering and related fields at a postsecondary institution. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, and National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the fourth and final course for the Agricultural Engineering and Applied Technologies program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Safety

1) Identify the benefits of knowing and applying basic safety procedures in both an agricultural laboratory and workplace. Interpret current Occupational Safety and Health Administration (OSHA) guidelines to conduct a compliance review of the agricultural laboratory, including a written summary justifying the findings with recommendations for improving the safety of working conditions. (TN Reading 1, 2; TN Writing 1, 4, 7, 9)

2) Review common laboratory safety procedures for tool and equipment operation in the agricultural and biosystems engineering laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

Occupational Research and Awareness

3) Gather and analyze information from multiple authoritative sources such as the United States Bureau of Labor Statistics to develop a written projection of the occupational trends related to agricultural engineering. Supplement the narrative with relevant and properly cited charts, graphs, and other visual representations. (TN Reading 1, 9; TN Writing 2, 7, 9)

Project Planning and Management

4) Design a project plan for an agricultural engineering project, outlining a strategy for working within a given set of parameters, constraints, and resources. Include in the plan components related to the budget, timeline, safety considerations, and strategies to minimize adverse environmental impacts. (TN Writing 4, 9)

Geographic Information Systems, Precision Measurements, and Management

5) Synthesize case studies and field experience to provide evidence of the impact of geographic information systems (GIS) and global positioning systems (GPS) on agricultural demographics, precision agriculture, pasture management, water quality, watershed management, and waste pollution. Discuss the implications for industry and labor with the incorporation of these technologies into more and more facets of agricultural life. (TN Reading 1, 9; TN Writing 2, 7, 9)

6) Identify various GIS and GPS applications and explain their uses in precision agriculture, including but not limited to the following: precision agriculture management zones, crop water

and drought areas, crop imaging, land correlation to crop yields, yield map cleaning and management, drainage analysis and tile mapping, crop data analysis, soil darkness mapping, suitability modeling, and slope angle and accuracy. (TN Writing 2, 7, 9; TN Math N-Q)

7) Demonstrate the ability to make land use, management, development, and equipment recommendations for a specific plot of land in rural and urban settings. Provide graphical and textual evidence to support each recommendation. (TN Reading 1, 3, 7; TN Writing 2, 7, 8, 9)

Geographic Information Systems, Irrigation, and Drainage

8) Analyze, map, and disseminate geographic information systems (GIS) and global positioning systems (GPS) data portraying a drainage map of a specified region. Citing specific evidence from findings, propose changes to drainage and irrigation systems and justify recommendations against accepted soil erosion control practices. (TN Reading 3, 9; TN Writing 1, 4, 6, 8, 9; TN Math N-Q, S-ID, S-IC)

9) Describe the relationships between concepts of hydrostatics, kinematics, and dynamics of fluid flows used for agricultural industry irrigation systems, including but not limited to pipes and open channels, using domain-specific language. (TN Reading 4, 5; TN Writing 9)

Structures: Environmental Impacts, Efficiency, and Certifications

10) Research agricultural buildings and facilities that meet industry benchmarks for energy efficiency and environmental sustainability. Collect observations on the costs and benefits of such structures and make recommendations to conserve energy and decrease operational cost, developing claim(s) with specific evidence from research. (TN Reading 1, 7; TN Writing 1, 7, 9)

11) Create a detailed construction plan for an agricultural facility suitable for a designated site, using natural systems and renewable energy where possible, and conserving energy and material resources in construction and maintenance while meeting building certification requirements. Include plans for recreating land or environments impacted by the construction (i.e., replacing displaced wetland with an artificial wetland). (TN Reading 3, 7; TN Writing 2, 7, 9)

Biophysical Properties of Crops and Food Products

12) Analyze the physical properties of selected agricultural crops and food products as they impact harvesting, storage, processing, and transport requirements, including but not limited to density, shape, moisture content, water potential, friction and flow of particulate solids, terminal velocity, thermal properties, and viscoelastic behavior of solids. Develop a fact sheet detailing the appropriate harvesting, storage, processing, and transportation equipment required for the range of crops and products analyzed, providing written justification for the use of chosen equipment. (TN Reading 1, 7, 8, 9; Writing 2, 8; TN Math N-Q, A-SSE, A-REI, G-C, G-GMD, G-MG)

Biochemistry of Agricultural Fertilizers and Chemicals

13) Develop a safety, storage, and disposal plan for agricultural chemicals such as pesticides, fertilizers, and veterinary medicines. Outline specific procedures pertaining to responsible

selection and storage, mixing, transport, application, and disposal of waste, in compliance with applicable regulatory standards. (TN Reading 1, 3; TN Writing 2, 4, 8, 9)

14) Analyze the chemical and physical properties of selected agricultural fertilizers and chemicals in relation to specific crops and determine the most efficient and effective method of application. Demonstrate in a live setting or presentation the ability to calibrate equipment for liquid, solid, and gaseous applications. (TN Reading 3, 7, 9; TN Writing 2, 9)

Capstone Project

15) Participate in a team-driven agricultural engineering project approved by the instructor that includes research, planning, analysis, construction, testing, and evaluation phases to measure success and adherence to legal constraints. Prepare periodic oral and written reports to demonstrate progress. (TN Reading 1, 7, 9; TN Writing 2, 4, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 6, 8, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 11-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Modeling, Geometry, Statistics and Probability.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards. Students who are engaging in activities outlined above should be able to

demonstrate fluency in Standards in CS, PST, ABS, NRS, PS, and ESS systems at the conclusion of the course.

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Agribusiness

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5946
Prerequisite(s):	*Agriscience* (5957)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the second course in the *Agribusiness* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/ Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Principles of Agribusiness teaches students to apply the economic and business principles involved in the sale and supply of agricultural products to a wide range of careers across the industry and builds foundational knowledge of finance and marketing principles. Upon completion of this course, proficient students will be prepared for more advanced coursework in the Agribusiness program of study. ~~Standards in this course are aligned with Tennessee English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics, as well as National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*~~

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the second course in the *Agribusiness* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Introduction to Agribusiness

1) Explore and compare local, regional, state, national, and global career opportunities in the agribusiness industry. Drawing evidence from multiple sources, such as but not limited to the United States Bureau of Labor Statistics, Organisation for Economic Co-operation and Development, and Tennessee Department of Labor and Workforce Development, to evaluate labor data on viable career pathways in an agribusiness-related field. Describe in a written or visual representation the knowledge, skills, and abilities necessary for a range of careers in agribusiness. (TN Reading 1, 9; TN Writing 4, 7, 9)

2) Examine specific business practices, laws, regulations, and technologies that have evolved within the agribusiness sector, and evaluate the economic and societal implications of each. Explain in an informative essay how these advances have influenced the agriculture industry, citing specific textual evidence from case studies or legislation. (TN Reading 1, 2; TN Writing 2, 4, 7, 9)

3) Create a graphic illustration comparing and contrasting regulations in the United States with those in countries from which the U.S. imports agricultural products, citing evidence from governmental agencies and news organizations. Analysis should address governing agencies, subsidies, and trade agreements. (TN Reading 1, 7, 9; TN Writing 7, 9)

Business Concepts and Structures

4) Compare and contrast types of business ownership models including at minimum the following: sole proprietorship, partnerships, small businesses, cooperatives, limited liability corporations, and corporations. In a narrative referencing agribusiness examples, explain the organizational structure of each model and describe its advantages and disadvantages to both owner and customer. (TN Reading 4, 5, 9; TN Writing 2, 4, 7, 9)

5) Write a business plan for an agricultural entrepreneurial enterprise that includes basic business and entrepreneurship principles such as budget, target customer, product information and risk assessment. Develop a three minute speech to pitch the plan to prospective investors. As an extension, apply principles of the business plan for use as a Supervised Agricultural Experience (SAE) program. (TN Writing 4, 9)

6) Define and analyze the relationships among basic business concepts used in agribusiness, including the business cycle, profit, loss, competition, equilibrium price, ethics, social responsibility, and supply and demand. Develop a visual representation (i.e., chart, table, graph,

mind map) to illustrate situations that would affect supply and demand of an agricultural product nationally and globally. (TN Reading 4, 5, 7; TN Writing 9)

Accounting Practices

7) Using case studies, actual spreadsheets, forms, and instructional materials, explain how components of financial recordkeeping affect operations and management decisions for an agricultural enterprise. Components include the general journal, balance sheet, cash flow statements, financial statements, reconciliation of accounts, depreciation, net worth, income statements, and profit and loss statements. (TN Reading 2, 5; TN Writing 9)

Markets and Futures

8) Compare the costs affecting the production of agricultural products (such as basic logistics, input costs) with the costs of producing and marketing non-agricultural products. (TN Math N-Q)

9) Research and explain the economic impact of agriculture futures and commodities on the local, state, national and the global economy. Identify the top ten agricultural commodities and describe the factors that impact their values and trading patterns. Predict the value of each commodity at a specified point in time. (TN Reading 5; TN Writing 4, 7, 9; TN Math N-Q, TN Math S-CP)

10) Compare and contrast the sale of agricultural products through local marketing (such as farmers markets, buyers, and marketing cooperatives) to the sale of products in futures markets, supporting analysis with graphic illustrations (such as charts, tables, graphs) and explanatory narratives. (TN Reading 1, 5, 7, 9; TN Writing 2, 4, 7, 9; TN Math N-Q, S-ID)

Sales and Marketing

11) Describe basic marketing principles fundamental to the sale of agriculture products, including but not limited to benefit and cost analysis, impact and application of online mediums, value-added, and niche marketing.

12) Research an agricultural product or service to determine its features and consumer benefits. Identify appropriate marketing strategies and target audiences; develop and present materials designed to market the product or service. (TN Reading 2; TN Writing 4, 7, 9)

13) Demonstrate understanding of basic sales principles by writing scripts for a role play between an agricultural product salesperson and a customer. Include determination of customer needs, presentation of features and benefits, possible objections, suggestive selling item(s), and closing strategies. Follow up with techniques used for post-sale communications. (TN Writing 4)

14) Develop and present an agricultural marketing or sales plan on a specific product or service. The plan should include at least the following: a mission statement, long- and short-term smart goals, target markets, profit and loss projections, industry trends, and product samples. (TN Writing 4, 7, 9)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 1, 3, 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards ABS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Organizational Leadership and Communications

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5956
Prerequisite(s):	*Principles of Agribusiness* (5946)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the third course in the *Agribusiness* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities available with specific universities, including Middle Tennessee State University.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Organizational Leadership and Communications is an applied-knowledge course for students interested in learning more about the attributes and skills of successful leaders in the agriculture industry. This course covers organizational behavior, communication, management, and leadership topics. Students participate in activities that will assist them in the development of communication and interpersonal skills transferrable to any agribusiness application. Upon completion of this course, proficient students will be prepared for the level-four *Agricultural Business and Finance* course and advanced study at a

Approved April 10, 2015; Amended April 15, 2016

postsecondary institution. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects as well as National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*

Program of Study Application

This is the third course in the *Agribusiness* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Standards

Career Awareness

1) Use local news media, organizational websites, and real-time labor market information to investigate occupations in business leadership and communications. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. (TN Reading 2, 9; TN Writing 4, 7, 9)

2) Demonstrate the ability to prepare basic personal and business records to complete taxes, employment, and SAE related applications, including resume, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements. (TN Reading 3; TN Writing 4)

Organizational Structure and Performance

3) Consult case studies, business journals, and news articles to determine the relationships between organizational performance and human capital, social capital, organizational learning, total quality management, and customer satisfaction. Analyze case studies to identify the elements supporting high-performing organizations and describe how successful agribusinesses incorporate them. (TN Reading 2, 4, 5; TN Writing 2, 9)

4) Define organizational behavior, citing examples from agricultural businesses currently in operation. Produce a narrative or annotated timeline analyzing the major developments and features of the agriculture industry that have influenced changes in organizational behavior over the past century. These features include but are not limited to: scientific advancements, transportation of goods, labor market shifts, labor organization, the rise of large corporations, subsidies, automation, information technology, and globalization. (TN Reading 4; TN Writing 2, 8, 9)

5) Compare and contrast characteristics of models of organizational change. Analyze a case study in which an organization faced an unplanned change and develop a written argument supporting transformational change as a preventive measure. (TN Reading 9; TN Writing 1, 9)

6) Differentiate between extrinsic and intrinsic motivation and summarize how each influences employee productivity. Develop a list of strategies for motivating individuals or groups and write business scenarios in which the strategies apply. (TN Reading 1, 2; TN Writing 4, 9)

7) Create an annotated graphic (such as a flowchart, table, or mind map) illustrating the stages of team development. Draw conclusions about the advantages and disadvantages of group decision-making and evaluate the potential effectiveness of group decision-making at each stage. (TN Reading 5, 7; TN Writing 1, 4)

Communication

8) Practice effective verbal and nonverbal communication for use in business environments via role-plays. Contrast communication appropriate for an agribusiness environment versus an informal setting.

9) Recognize the consequences of poor communication skills and describe the importance of effective communication among team members. Apply concepts of giving and receiving oral and written instructions to accomplish a complex task. (TN Reading 3)

10) Define constructive criticism; analyze potential conflicts involved in giving and receiving feedback; and create a plan for engaging in productive dialogue. Role-play work-related feedback as an employer and as an employee. Demonstrate active listening and appropriate response skills.

11) Cite evidence to support the idea that conflict is a normal part of work relationships. Compare and contrast assertive and aggressive communication in conflicts. Apply concepts pertaining to different methods for handling conflicts by participating in role-play exercises and constructively critiquing the practices of others. (TN Reading 1, 9)

12) Analyze the potential customer impact of sample verbal, print, and electronic communications in agribusiness. Examine case studies in which various forms of communication have facilitated or hampered effective business operations. (TN Reading 9)

Management and Leadership

13) Develop a hypothesis surrounding the character traits and interpersonal skills needed by effective agribusiness managers. Determine which individual traits and skills can be developed and create a plan for personal growth. Example traits and skills include but are not limited to: enthusiasm, effective communication, decision making, risk evaluation, self-discipline, integrity, lifelong learning, and teamwork. (TN Writing 4)

14) Analyze the outcomes of case studies or current events and critique how organizational leaders managed people and made decisions. Write a narrative advocating alternative management strategies that would benefit the organization and which lead to either a better financial outcome or improved employee motivation. (TN Reading 2, 6, 8; TN Writing 1, 9)

15) Define organizational culture and evaluate the role of business leaders in establishing and maintaining a workplace in which employees work cooperatively with others from diverse backgrounds. (TN Reading 6)

16) Research a variety of project management models and create a visual representation to show important connections and distinctions between the essential phases of each model. Select one model and modify it to meet the needs of a sample organization; justify its application in an agribusiness setting. (TN Reading 7, 8, 9; TN Writing 1, 8, 9)

17) Research professional ethical standards from recognized national organizations (such as the United States Department of Agriculture – Rural Business Cooperative Service). Synthesize principles from the standards to create a personal code of agribusiness ethics designed to address professional, ethical, and legal issues such as:
    a. Conducting business with friends, relatives, or competitors
    b. Sales incentives
    c. Pricing policies
    d. Illegal practices
    e. Behavior toward customers, employees, and shareholders
    (TN Reading 1, 2; TN Writing 4, 7, 9)

18) Demonstrate knowledge of basic parliamentary procedures by planning and conducting a simulated annual or monthly stockholders meeting for a small agricultural corporation or cooperative. Develop an agenda and take official minutes. Identify meeting materials to be used, including data and reports, and outline the responsibilities of organizational leadership in facilitating the meeting. (TN Reading 3; TN Writing 4)

Innovation and Influence

19) Formulate a hypothesis about the relationship between the stages of innovation adoption (knowledge, persuasion, decision, implementation, confirmation) and the rate of innovation adoption (innovator, early adopter, early majority, late majority, laggard). Analyze the role that opinion leaders play in the adoption process. Write coherent arguments based on evidence from real-world examples to support the hypothesis. (TN Reading 1, 2, 6, 9; TN Writing 1, 4, 9)

20) Analyze case studies of stakeholder resistance to change, identify the causes, and propose measures for overcoming resistance. (TN Reading 2, 6, 8; TN Writing 1, 9)

21) Compare and contrast theories of persuasion and influence (reciprocity, commitment, social proof, liking, authority, scarcity) and apply these theories to agricultural sales and marketing communications. (TN Reading 5)

22) Synthesize the understanding of stakeholder resistance, adoption models, and persuasion theories. Develop a sales plan for a new agricultural product or service (such as commodity trading to farmers). Deliver a focused, coherent presentation on the plan. (TN Reading 1, 2, 7; TN Writing 2, 4, 8, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standard CS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Agricultural Business and Finance

Primary Career Cluster:	Agriculture, Food and Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5943
Prerequisite(s):	*Organizational Leadership and Communications* (5956)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses. In addition, this course satisfies the *Personal Finance* requirement for graduation.
Programs of Study and Sequence:	This is the fourth and final course in the *Agribusiness* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	A statewide dual credit challenge examination exists for this course for students to earn dual credit at Tennessee public postsecondary institutions that offer agriculture. For more information, please visit http://www.tn.gov/education/opca/.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	Teachers must attend the state approved training to teach personal finance for this course to satisfy the personal finance requirement.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Agricultural Business and Finance is an applied course that addresses the economic and business principles necessary to operate a successful agribusiness. The course covers a wide range of topics in business, finance, economics, and management. Upon completion of this course, proficient students will have learned to apply the principles drawn from these topics toward activities that support their own business aspirations in the agriculture industry. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in

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Mathematics, and National Agriculture, Food and Natural Resources Career Cluster Content Standards.* *Agricultural Business and Finance* is a dual credit course with statewide articulation.

Program of Study Application

This is the fourth and final course in the *Agribusiness* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food and Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

History and Evolution of Agribusiness

1) Explore the evolution of agribusiness in the United States by describing the modern agribusiness sectors and identifying historical milestones impacting their development. Using local job postings and labor and workforce data, research occupations in agribusiness and management, and identify the knowledge, skills, and abilities necessary for employment. (TN Reading 1, 2, 9; TN Writing 7, 9)

2) Write an informative essay that compares and contrasts different business and ownership models of agribusinesses (such as proprietorships, partnerships, corporations, limited liability companies, franchises, and cooperatives). Include the scope, economic impact, and future trends of a specific type of agribusiness locally, regionally, nationally, and globally, citing specific evidence from news articles or government publications. (TN Reading 1, 7; TN Writing 2, 8)

3) Demonstrate the ability to prepare basic personal and business records to complete taxes, employment and SAE related applications, including resume, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements. (TN Reading 3; TN Writing 4; TN Math N-Q)

Saving, Investing, and Financing

4) Examine different forms of saving, investing, and financing by researching available financial services at banks, credit unions, and savings and loans. Justify a selected financial service option for a specific personal and/or agribusiness use by developing a claim and supporting it with reasoning and evidence pulled from the financial institution. (TN Reading 2; TN Writing 1, 7, 9)

5) Apply principles of consumer finance, savings, investing, and loans to develop personal and agribusiness budgets. (TN Math N-Q, A-SSE)

6) Using visual representations and mathematical equations, compare and contrast the differences between personal, business, and farm financing, including but not limited to sources, terms, and available risk management strategies (such as insurance, investments, and commodity trading). Using quantitative reasoning and appropriate units, calculate simple and compound interest for a given financing option. (TN Reading 2, 4, 7; TN Math N-Q, A-CED, A-REI)

Recordkeeping and Accounting

7) Articulate the components of a business plan, and research exemplars from national or local companies. Demonstrate the ability to prepare basic personal and business records, including budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements. (TN Reading 3; TN Writing 4; TN Math N-Q)

8) Differentiate between bookkeeping and accounting. Justify the need for organized recordkeeping processes as an integral part of a comprehensive management system.

9) Apply fundamental principles of financial recordkeeping to agribusiness planning, logistics, and operations, including at a minimum the following:
   a. Differentiating between fixed and variable costs
   b. Determining pricing methods
   c. Using general ledger and basic accounting principles (accrual vs. cash basis)
   d. Calculating depreciation
   e. Estimating simple and compound interest
   (TN Math N-Q, A-CED, A-REI)

10) Consult technical texts to research and generate connections regarding the relationships between depreciation, taxation, and insurance. (TN Reading 5)

Consumer Finance

11) Craft an argumentative essay that makes a claim about the importance of a specific responsible personal finance practice in agribusiness. Develop claim(s) and counterclaim(s) fairly with reasoning and evidence about the factors impacting credit and income. Include basic financial management and financial security tips. (TN Reading 2; TN Writing 1)

12) Examine essential principles of consumer finance by summarizing common banking procedures and services, including establishment of personal and operating accounts. Compare and contrast costs and benefits of financial services based on personal characteristics, wealth, debt, and risk management. (TN Reading 2, 4; TN Writing 7, 9)

Economics of Agribusiness

13) Explain how economic principles apply to agribusiness, including macro versus micro systems, factors and effects of competition, inflation, pricing, and supply and demand relationships. (TN Reading 2, 4, 5; TN Writing 2; TN Math N-Q)

14) Analyze the role of government in setting monetary, fiscal, and taxation policies that affect the operations of agriculture businesses, including the sale of farm commodities. Investigate specific crops and discuss how economic policies set by the government impact the pricing and sale of a commodity, citing evidence from legislation and news articles. Determine the impact such policies have on consumers and producers. (TN Reading 1, 2, 4, 5; TN Writing 2, 7; TN Math S-ID)

15) Assess the global impact of American commodities on world food markets. Select a commodity produced in America and research foreign trade laws governing its sale. Make a claim about

how these laws affect supply and demand in world economies, developing claim(s) and counterclaim(s) with reasoning and evidence from governmental agencies, non-profits, and news articles. (TN Reading 1, 2, 4, 7; TN Writing 1, 7, 8, 9)

Business Planning and Management

16) Assess the importance of entrepreneurship in society. Differentiate between characteristics of successful and unsuccessful entrepreneurial endeavors. Evaluate methods for identifying opportunities in entrepreneurship and outline the major steps in starting an agribusiness. (TN Reading 2; TN Writing 4, 7)

17) Develop and present a comprehensive business plan for an agriculture-related business. Address at minimum the following components: type of agricultural ventures, projected profits, expenses, margins, returns on investment, and facilities and equipment needs. (TN Writing 4; TN Math N-Q)

18) Analyze case studies to illuminate the specific challenges of running an agriculture-related business. Determine the role that effective managerial skills play in an agribusiness venture to hypothesize the appropriate managerial skills for a variety of operational issues. (TN Reading 7)

19) Summarize the history of agriculture-related policy development at the state and national levels. Research and identify major regulatory agencies and outline the principle policies governing modern agribusinesses, citing evidence from specific legislation. Compose an argumentative essay to make a claim supporting or opposing a specific government regulation in agriculture. (TN Reading 2, 8; TN Writing 1, 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 8, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Statistics and Probability.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and statistical reasoning as applied to specific

> ~~technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~

- SAE: [Supervised Agricultural Experience](): All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: [National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards](): Students engaged in activities outlined above should be able to demonstrate fluency in Standards ABS and CS at the conclusion of the course.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning]()
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Food Production

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6118
Prerequisite(s):	*Agriscience* (5957)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the second course in the *Food Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Principles of Food Production is an intermediate course in plant and animal agriculture for students interested in pursuing careers in production agriculture or food science. Students study principles related to plant and animal structural anatomy, systems physiology, economics of production, genetics and biotechnology, and other management approaches associated with plant and animal production. Upon completion of this course, proficient students will be prepared for more advanced coursework in the Food Science program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics,~~

Approved April 10, 2015~~; Amended April 15, 2016~~

Program of Study Application

This is the second course in the *Food Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Introduction to Plant and Animal Agriculture and Safety

1) Research the roles and contributions of plants and animals in meeting the food and fiber needs of society using government agency data, news articles, and instructional resources. Identify and describe in an informative text the different aspects of plant and livestock production (such as product selection, site selection, optimal development, harvesting, and marketing), and examine characteristics of occupations in the field. ~~(TN Reading 1; TN Writing 2)~~

2) Describe the scope and economic importance of plant and animal agriculture in the United States and the world, using quantitative data compiled by government agencies and news media. Summarize trends in crop and livestock production in Tennessee, citing information from the Tennessee Department of Agriculture. ~~(TN Reading 1, 2; TN Writing 4, 9)~~

3) Review common laboratory safety procedures for tool and equipment operation in the food science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. ~~(TN Reading 3)~~

Principles of Plant Science for Agricultural Production

4) Differentiate between major plant species used for vegetable, forage, fruit, and agronomic crop production. Describe basic principles of plant science needed to produce healthy crops for high quality food products. ~~(TN Biology II 7)~~

5) Identify and describe the general growth and development processes of crops used for food production. Synthesize information from a range of sources to analyze plant anatomy, physiology, genetics, and reproduction in the context of plant growth and productivity, including the following:
    a. Describe different plant types based on their anatomy and physiology
    b. Investigate the relationship between form and function for the major plant structures
    c. Examine the components of the plant reproduction system and identify specific anatomical features on different species and varieties of plants
    d. Demonstrate cross-breeding techniques to enhance identified traits and characteristics
    ~~(TN Reading 7, 9; TN Writing 8; TN Biology II 7)~~

6) Relate principles of disease and parasite control to the health, growth, and maintenance of food crops. Compare and contrast methods for disease and parasite controls, distinguishing between prevention and treatment methods. ~~(TN Biology II 7)~~

7) Document, using either a chart, table, graph or graphic organizer, the optimum levels of specific nutritional factors that influence plant health (such as pH, nitrogen, potassium, etc.). Identify nutritional deficiencies and disorders and make recommendations for the safe production of major food crops. ~~(TN Reading 7; TN Biology II 7)~~

Principles of Soil Science for Plant and Animal Production

8) Evaluate the physical and chemical properties of soils needed for optimum food crop production. Perform technical procedures to classify soils for agricultural production by evaluating factors such as soil pH, texture, permeability, drainage class, soil depth, and water holding capacity. Interpret test results and formulate conclusions regarding production use suitability. ~~(TN Reading 3)~~

9) Research the factors that influence soil erosion rates, and compare soil conservation practices used for maintaining a healthy growing environment for plant and animal production. ~~(TN Writing 7; TN Environmental Science 4)~~

10) Analyze practices for land selection and conservation that ensure optimal productivity in crop development and livestock operations. Using information from government agencies (such as Tennessee Extension Service, Natural Resources Conservation Service), cite examples of best management practices that ensure the appropriate use of land resources and maximize crop yields and determine the extent to which evidence provided supports them. ~~(TN Reading 8; TN Writing 9; TN Environmental Science 4, 7)~~

11) Identify environmental factors (such as climate and topography) considered in site selection to ensure optimal production and economic return for plant and animal production, depending on intended use and location (rural, suburban, and urban). ~~(TN Environmental Science 4)~~

Principles of Environmental Science for Plant and Animal Production

12) Research sustainable practices and principles applicable to food crop and animal production. Craft an argumentative essay recommending management practices for a specific setting (rural, suburban, urban) by developing a claim with reasoning and evidence that incorporate soil and water conservation principles. ~~(TN Writing 1, 4, 7; TN Ecology 6; TN Environmental Science 4, 7)~~

13) Debate water, air, and noise pollution issues associated with agricultural production, and recommend control measures for rural, suburban, and urban areas, citing evidence from specific case studies. Demonstrate adherence to procedures for handling, storing, and disposing of production waste in compliance with relevant laws and regulations in a variety of plant and animal settings. ~~(TN Reading 3; TN Writing 1; TN Environmental Science 6, 7)~~

Principles of Animal Science for Agricultural Production

14) Identify the major breeds of production animals (such as cattle, sheep, goats, poultry, swine, and specialty animals) and their associated food and fiber products, citing specific textual evidence of characteristics. Explore the basic principles of animal science needed to produce healthy livestock for high quality food and fiber products (such as nutrition, reproduction, and breed selection). (TN Reading 1; TN Writing 9)

15) Identify and describe the general growth and development processes of production animals used for food and fiber production. Analyze animal anatomy, physiology, genetics, and reproduction in the context of animal growth and productivity, including the following:
    a. Describe different animal types based on their anatomy and physiology
    b. Examine the components of the animal reproduction system and identify specific anatomical features on different species and varieties of production animals
    c. Demonstrate understanding of cross-breeding techniques to enhance identified traits and characteristics
    (TN Reading 9; TN Writing 8)

16) Research principles of disease and parasite control and relate them to livestock health, growth, and maintenance. Recommend safe methods for disease and parasite prevention and treatment, citing established scientific and industry guidelines. (TN Reading 2, 8; TN Writing 7, 9)

17) Use professional and academic journals and/or publications from UT and TSU Cooperative Extension Service to research and document connections between proper nutrition and animal health. Apply principles of proper nutrition to maximize livestock gains and cost efficiency, by:
    a. Making specific diet recommendations, based on animal breed, available resources, costs, and nutritional requirements and justifying recommendations with specific textual evidence
    b. Differentiating between various diet alternatives to determine which ration is most cost effective to obtain maximum production
    (TN Reading 1, 4, 5; TN Writing 1, 7, 9)

18) Summarize how heritability, selection intensity, and generation interval are important to genetic change in production animals, including:
    a. Explaining how each concept impacts genetic change
    b. Comparing and contrasting characteristics of each as a tool for animal producers
    c. Determining how long it will take to get specific traits, using each method
    (TN Reading 1, 2; TN Writing 8, 9; TN Biology I 4, TN Biology II 4)

Principles of Agribusiness for Plant and Animal Production

19) Identify and critique factors that influence the economics of crop and livestock production in the United States and the world. Using informational texts and graphic illustrations published by government agencies, interpret production costs for various types of plant and animal operations that impact the wholesale cost of food. (TN Reading 4; TN Writing 2, 9)

20) Using local news media, advertisements, and information from production companies, explore and compare marketing methods and strategies to develop opportunities for specialty plant and animal products in niche markets. (TN Reading 1, 6, 8)

21) Identify and describe the American factors impacting global commodity markets. Compare and contrast, through debate, different factors that impact food prices in specific scenarios (such as the impact of a war, economic sanctions, or weather on local food prices). ~~(TN Reading 2, 4)~~

Plant and Animal Biotechnology

22) Examine the role and importance of genetic principles in improving plant and animal production. Summarize the important historical achievements in plant and animal biotechnology. Research current and emerging plant and animal biotechnologies and craft an argumentative essay to debate the use of biotechnology in production agriculture. Justify claims surrounding the ethical, legal, practical, and economic issues related to food production and biotechnology with evidence drawn from scientific and professional resources. ~~(TN Reading 2, 8; TN Writing 1, 7)~~

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN Biology I: Tennessee Science: Biology I, Standard 4~~
- ~~TN Biology II: Tennessee Science: Biology II, Standards 4, 6, and 7~~
- ~~TN Ecology: Tennessee Ecology, Standard 6~~
- ~~TN Environmental Science: Tennessee Science: Environmental Science, standards 4, 6, and 7~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards AS, BS and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Food Science and Safety

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6115
Prerequisite(s):	*Principles of Food Production* (6118)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the third course in the *Food Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit http://tn.gov/education/cte/work_based_learning.shtml.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing local opportunities, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Food Science and Safety is an applied-knowledge course designed for students interested in careers in food science. The course covers fundamental principles of food science, food safety and sanitation, foodborne pathogens, and food-related standards and regulations. Upon completion of this course, students will be versed in the technical knowledge and skills necessary for further education and careers in food science. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee state standards in Chemistry I and Environmental Science, as well as National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the third course in the *Food Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, and Natural Resources website at http://www.tn.gov/education/cte/AgricultureFoodNaturalResources.shtml.

Course Standards

Introduction to Food Science Industry and Careers

1) Using news media and relevant academic journals investigate current applications of food science and describe the scope and economic importance of the food industry in the United States, including imports and exports. Citing specific textual evidence, describe how the study of food science and related sciences impacts quality of life and enhances a Supervised Agricultural Experience (SAE) program. (TN Reading 1; TN Writing 8)

2) Use local news media, organizational websites, and real-time labor market information to investigate occupations in food science. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. (TN Reading 2, 9; TN Writing 4, 7, 9)

3) Create a chart, table, or graphic to illustrate significant trends with regard to supply and demand of food products across the world population, citing specific textual evidence from news media and government agency reports. Identify and summarize common environmental and safety concerns regarding food production and the food supply. (TN Reading 1, 2, 7; TN Writing 9; TN Environmental Science 3)

4) Review common laboratory safety procedures for tool and equipment operation in the food science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

Food Chemistry

5) Differentiate between each food group and compare and contrast their nutritive values. Explain how chemical and physical properties of foods influence nutritional value and quality. Examine the basic principles of proper nutrition, including the identification and evaluation of the six essential nutrients needed for good health. (TN Reading 4; TN Writing 7; TN Chemistry 1)

6) Investigate and apply the concepts of basic chemical processes and interactions of constituent components of foods. Through experimentation and observation, identify chemical properties of food that are affected by production, processing, and storage. (TN Reading 3)

7) Identify common food additives (preservatives, antioxidants, stabilizers, colors, and flavors) and describe their general purposes. Synthesize information from academic journals and news media to summarize safety issues associated with food additives, assessing the extent to which the reasoning and evidence provided supported claims made. (TN Reading 2, 8; TN Writing 8)

Food Microbiology

8) Examine the role of microorganisms in food products and evaluate the implications for human consumption. ~~(TN Writing 7)~~

9) Research common microorganisms that cause fermentation, discuss the benefits or dangers of fermentation in food products and processing. Develop an annotated chart that illustrates fermentation techniques and the foods they are used to create, describing the basic chemical principles of fermentation and the factors that affect the fermentation process. ~~(TN Reading 2; TN Writing 2, 4)~~

Food Preservation

10) Differentiate among the various microorganisms that cause food spoilage and determine their life cycles. Compare and contrast the application of food preservation methods to prevent the growth of microbes in food. Outline the processes for heating, refrigerating, and freezing for food preservation. ~~(TN Reading 2; TN Writing 4)~~

Food Safety and Sanitation

11) Research and cite texts identifying types and general characteristics of microorganisms associated with foodborne illnesses. Summarize safe food habits and practices by researching proper procedures for safe handling, storage, preparation, and cooking; to compose a checklist of general safety guidelines for different food groups, such as fruits and vegetables, red meat, fish, eggs, and dairy products. ~~(TN Reading 1, 2; TN Writing 4)~~

12) Describe procedures and inspection standards for sanitation in the food production industry. Demonstrate in a live setting or in a presentation format the ability to follow procedures for appropriate chemical selection, cleaning techniques, and insect and rodent control methods. Identify concepts and principles that provide the scientific foundation for current food sanitation standards. ~~(TN Reading 3; TN Writing 7, 8)~~

13) Research principles and applications of the Hazard Analysis and Critical Control Point (HACCP) system and describe how they apply to food safety. Interpret food industry inspection standards to assess conditions related to food safety and sanitation. Create a model HACCP plan including a summary of procedures to control biological, chemical, and physical hazards in food production. ~~(TN Reading 2, 3, 4; TN Writing 4)~~

Food Safety Laws and Regulations

14) Analyze state and federal laws and regulations governing food inspection standards, and argue for their importance to public health, citing specific evidence from case studies to develop your claim. Define the roles of state and government agencies responsible for the establishment and enforcement of food safety regulations. Compose a narrative that interprets the regulations governing the "Local Foods for Local Schools" program in Tennessee. ~~(TN Writing 1, 2)~~

Food Science Trends and Issues

15) Research major development trends in the food science industry by analyzing documents authored by for-profit companies and lobbying organizations, defining the question each seeks to address. Compare and contrast the use of advanced technologies in food production, such as but not limited to biotechnology, irradiation, and genetically modified organisms (GMOs), citing specific textual evidence. Summarize technology principles, process effects, and consumer concerns, referencing the extent to which reasoning and evidence presented for each supports specific claims. (TN Reading 2, 6, 8)

16) Formulate a hypothesis regarding a current food science issue. Design and conduct an original experiment to prove or disprove the hypothesis. Collect the appropriate data to evaluate claims, synthesizing and communicating results within the broader context of food science. (TN Writing 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- TN Chemistry: Tennessee Science: Chemistry I standard 1 may provide additional insight and activities for educators.
- TN Environmental Science: Tennessee Science: Environmental Science standard 3 may provide additional insight and activities for educators.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in activities outlined above should be able to demonstrate fluency in Standards CR, FPP, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advanced Food Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6113
Prerequisite(s):	*Food Science and Safety* (6115)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Food Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture, Food, & Natural Resources students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit http://tn.gov/education/cte/work_based_learning.shtml.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Advanced Food Science is an applied course designed to prepare students for further education and careers in food science and technology. This course covers advanced principles of food science, characteristics and properties of food products, processing and grading techniques and skills, and food labeling and packaging principles. Upon completion of this course, proficient students will be able to pursue advanced training in food science at a postsecondary institution. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects,

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the fourth and final course in the *Food Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Introduction to Food Processing

1) Use local news media, organizational websites, and real-time labor market information to investigate occupations in food science. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. (TN Reading 2, 9; TN Writing 4, 7, 9)

2) Summarize how principles of food science are applied for the conversion of agricultural commodities into consumer products. Determine how food safety techniques applied in the home, at retail establishments, and in industrial food processing environments benefit human health. (TN Reading 2, 7, 9; TN Writing 9)

3) Review common laboratory safety procedures for tool and equipment operation in the food science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

4) Demonstrate the ability to prepare basic personal and business records to complete taxes, employment, and SAE related applications, including resume, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements. (TN Reading 3; TN Writing 4; TN Math N-Q)

Processing and Evaluation of Red Meat

5) Identify major species and breeds of livestock utilized for red meat production. Describe the fabrication, processing, packaging, and quality analysis of red meats and their by-products.

6) Explain carcass preparation and fabrication procedures and identify associated equipment, safety, sanitation, and quality control procedures. Demonstrate in a live setting or in a presentation format the ability to identify wholesale and retail cuts of meat and meat by-products, and correlate them to major muscle groups. (TN Reading 3)

7) Analyze the United States Department of Agriculture (USDA) inspection and grading procedures and compose an argumentative essay justifying their purpose in the food industry, developing claim(s) and counterclaim(s) with specific evidence from case studies found in news media. Describe the principles of quality and yield grading. Demonstrate in a live setting or in a

presentation format the ability to perform the evaluation and grading of carcasses, wholesale cuts, and retail cuts to determine maturity, final quality grade, and final yield grade, and provide written and oral justification for evaluation conclusions. (TN Reading 1, 3; TN Writing 1, 4, 9)

8) Demonstrate in a live setting or in a presentation the ability to perform methods of further processing fabrication for processed and value added products including comminuted meat products, emulsions, and cured meats. Using quantitative reasoning and appropriate units, calculate proper meat product formulations based upon required protein levels and USDA allowances for various products. (TN Reading 3; TN Math N-Q)

Processing and Evaluation of Milk and Dairy Products

9) Identify major breeds of livestock utilized for dairy production. Describe the products, by-products, processing, packaging, and quality analysis associated with each breed.

10) Summarize milk quality test and testing procedures in an explanatory narrative. Demonstrate in a live setting or in a presentation the ability to perform quality evaluations of milk and dairy products, providing written and oral justification for evaluation conclusions. (TN Reading 2, 3; TN Writing 2, 4)

11) Describe milk preparation and processing procedures, addressing procedures specific to equipment, safety, sanitation, and quality control. Analyze the composition of milk and examine concepts and principles that verify the scientific foundation for the pasteurization process. (TN Reading 3, 8; TN Writing 9; TN Math N-Q)

12) Identify varieties and characteristics of cultured and frozen milk products. Demonstrate in a live setting or presentation the ability to follow procedures used to process buttermilk, yogurt, and ice cream, attending to appropriate ratios and units. (TN Reading 3; TN Math N-Q)

13) Identify varieties, characteristics, and classifications of cheeses. Demonstrate in a live setting or presentation format the ability to follow procedures used to process, classify, and grade cheese, attending to appropriate ratios and units. (TN Reading 3; TN Math N-Q)

Processing and Evaluation of Poultry, Eggs, and Fish

14) Identify major poultry breeds and fish species utilized for meat and egg production. Describe the fabrication, processing, packaging, and quality analysis of poultry meat, eggs, and fish. (TN Reading 3)

15) Compare and contrast the carcass preparation and fabrication procedures in poultry and fish, addressing procedures specific to equipment, safety, sanitation, and quality control. Demonstrate in a live setting or in a presentation the ability to identify retail cuts of poultry, fish, and related by-products. (TN Reading 3)

16) Outline the United States Department of Agriculture (USDA) inspection procedures and system for classes, standards, and grades of poultry products and fish. Demonstrate in a live setting or in a presentation the ability to perform the evaluation and grading of carcasses and parts of chickens and turkeys, pre-cooked, further processed, and poultry meat products, providing

written and oral justification for evaluation and grading scores. Evaluate and grade eggs for interior and exterior quality and provide written and oral justification for evaluation conclusions. (TN Reading 3; TN Writing 1, 4)

Processing and Evaluation of Vegetables, Fruits, and Nuts

17) Explain the processing, packaging, and quality analysis of vegetables, fruits, nuts and their by-products.

18) Describe preparation and processing procedures for vegetables, fruits, nuts, and their by-products, addressing procedures specific to equipment, safety, sanitation, and quality control. Research and cite texts explaining the use of various monitoring systems to appraise food quality, such as the Brix scale. (TN Reading 1, 8; TN Writing 4, 7)

Food Product Packaging and Labeling

19) Identify laws regulating the packaging and labeling of food products, and summarize industry requirements in an explanatory text. Demonstrate in a live setting or in a presentation the ability to perform packaging and labeling procedures for different food products. (TN Reading 2, 3; TN Writing 4)

20) Research storage and transportation issues pertaining to packaged food products and the extent to which noted evidence and reasoning justifies implications for safety and quality, citing specific examples from news media and academic journals. (TN Reading 1, 6, 8; TN Writing 7, 9)

Food Product Marketing

21) Write an informative essay illustrating the application of fundamental economic principles such as supply, demand, and profit to the food science industry. Describe marketing considerations and methods of merchandising food products. Discuss how quality and yield grade factors affect product marketing. Revise, edit, and rewrite essay with peer feedback. (TN Writing 2, 5)

22) Develop a food product and create a processing, packaging, and marketing plan incorporating the skills learned in this course. (TN Writing 2, 4)

Consumer Issues

23) Review data from news media and company product recall notices to explore consumer satisfaction issues. Cite specific evidence to assess the impact of organic, natural, ethnic, religious-based, and other specialized processing methods in the food industry. Compare and contrast the advantages and disadvantages of value added and specialty products and conduct research to evaluate and summarize consumer interest and trends related to these products. (TN Reading 1, 2, 9; TN Writing 7, 9)

24) Investigate the food product development process. Evaluate the use of food batch procedures for the purpose of economic efficiency. Describe the application of sensory evaluation methods to test food product flavor, appearance, and texture by quantitative description and simple difference testing. (TN Writing 8; TN Math N-Q)

25) Identify consumer concerns related to food quality and safety (such as antibiotic use, genetically modified organisms (GMOs), pesticide use, and food borne illnesses), and discuss the economic implications when low-quality and unsafe foods enter the market.

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 4, 5, 6, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 6, and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Modeling, Geometry, Statistics and Probability.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards ABS, CS, and FPP at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Plant Science and Hydroculture

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6119
Prerequisite(s):	*Agriscience* (5957)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the second course in the *Horticulture Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Worker Protection Standard (WPS) for Agricultural Pesticides
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	While not required to teach the course, teachers who use a greenhouse facility or an outdoor lab (cold frame, nursery, etc.) that uses any type of chemical (with an EPA label) must have the Commercial Pesticide Applicators License for C10 and C15.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Principles of Plant Science and Hydroculture focuses on essential knowledge and skills related to the science of plant growth. This course covers principles of plant health, growth, reproduction, and biotechnology, as well as fundamental principles of hydroponics and aquaponics. Upon completion of this course, proficient students will be prepared for more advanced coursework in horticulture science.

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the second course in the *Horticulture Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, and Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Safety

1) Differentiate general occupational safety prevention and control standards as related to the plant science and hydroculture industry. Apply concepts of safety procedures to complete safety test with 100 percent accuracy. Obtain the worker protection standards student industry certification. (TN Reading 3)

Plants, Society, and the Environment

2) Investigate the roles of cultivated plants in meeting the food, fiber, fuel, medicinal, aesthetic, and occupational needs of society. Identify and describe, in an informative text, the different domains of the horticulture industry, and examine current issues and trends affecting professionals in the field. Cite specific textual evidence from government publications and news media. (TN Reading 1; TN Writing 2, 7, 8)

3) Summarize the impact and patterns of environmental factors on plant biodiversity by examining research from academic journals, news articles, and government publications. Describe important characteristics of the relationships between plants and other organisms, including basic plant-human interactions, plant-animal interactions, and plant adaptation. (TN Reading 2; TN Writing 4; TN Biology I 2, 5; TN Biology II 2, 5; TN Ecology 6; TN Environmental Science 2)

Principles of Soil Science

4) Evaluate, citing specific textual evidence, the physical and chemical properties of soils in an informative text. Perform technical procedures to classify soils by evaluating biotic and abiotic factors such as soil pH, texture, permeability, and water holding capacity. Interpret test results to identity deficiencies and formulate appropriate corrective actions. (TN Reading 3)

5) Describing factors that influence soil quality and erosion. Assess the extent to which reasoning and evidence presented in news articles or case studies support the use of a specific soil conservation practice for maintaining healthy growing media for plants. (TN Reading 8; TN Writing 2, 7)

6) Cite specific textual evidence for the analysis of land selection and conservation practices that ensure optimal productivity and stewardship. Identify factors that affect site selection for plant growth and draw evidence from multiple authoritative sources to appraise and justify management practices that ensure appropriate use of land resources. (TN Reading 1, 8; TN Writing 9; TN Ecology 6; TN Environmental Science 4)

Plant Structure and Function

7) Integrate print and digital sources to create a model depicting the parts of plant cells. Examine the structure and outline the functions of plant cell organelles. (TN Reading 2, 7; TN Biology I 1; TN Biology II 1, 7)

8) Analyze plant anatomy and physiology and relate key concepts to the processes and requirements involved in plant growth and productivity. (TN Biology II 6, 7)

Plant Nutrition

9) Analyze the nutrient requirements of plants and assess the importance of essential plant nutrients to plant growth and development. Use visual representations to illustrate the chemical and biological processes, including photosynthesis, that make nutrients available to plants for growth and maintenance. (TN Writing 4, 9; TN Biology II 7)

10) Justify the use of fertilizers as a source of essential plant nutrients. Calculate fertilizer formulations and perform different methods of fertilizer application. (TN Reading 1, 3; TN Math N-Q)

11) Research the nutritional factors that influence plant health to identify nutritional deficiencies and disorders. Compile observations to distinguish between the signs of nutrient deficiency in plants and defend recommendations for appropriate treatments. (TN Biology II 7)

Plant Diseases and Pests

12) Research the principles of disease and pest control to plant health, growth, and maintenance. Analyze the effects of different types of plant pests and diseases; prescribe methods for pest and disease prevention and treatment. (TN Reading 2)

13) Demonstrate understanding of common classes of chemicals used for pest management. Gather and evaluate information regarding PPE (Personal Protective Equipment) for chemical application and demonstrate appropriate use of PPE. Create a checklist for safe storage and handling of pesticides. (TN Reading 3; TN Writing 4)

Plant Breeding and Genetics

14) Analyze the reproductive structures in plants and describe how they function in both sexual and asexual plant reproduction. (TN Biology II 7)

15) Investigate the role of DNA, heritability, and genetic applications in plant breeding and compose an informative essay that describes how mutation, gene flow, and adaption influence plant

populations. Identify desirable traits in various plant species and predict the probable outcome of genetic crosses based on Mendel's laws. (TN Reading 3; TN Writing 2, 7; TN Biology I 4; TN Biology II 4)

Plant Biotechnology

16) Distinguish the branches of science that influence plant biotechnology and summarize important historical achievements. Examine the role and importance of genetic principles to improving plant characteristics and perform basic plant DNA extraction procedures. (TN Reading 2, 3; TN Writing 4; TN Biology I 4; TN Biology II 4)

17) Research current and emerging plant biotechnologies and construct an argumentative essay to support a claim supporting or opposing the use of a specific biotechnology in horticulture. Justify and debate ethical, legal, and economic issues surrounding plant biotechnology. (TN Reading 2, 8; TN Writing 1, 7)

Fundamentals of Hydroponics and Aquaponics

18) Evaluate the significance of hydroponics and aquaponics technology as related to sustainable practices and principles. Compare and contrast production systems and techniques utilized in the hydroponics and aquaponics fields, including structures and equipment, production methods, and common crops. (TN Ecology 6; TN Environmental Science 7)

19) Assess the functions, attributes, and desirable properties of soilless growing media. Write an informative essay to describe the major components of soilless media, identifying basic physical and chemical characteristics. (TN Reading 9; TN Writing 2)

20) Apply concepts learned in this course to visually identify common plant and animal species used for hydroponic and aquaponic production, and distinguish between their structural and physiological differences, as well as their specific production applications. (TN Reading 3; TN Biology II 6)

21) Examine the role that water chemistry plays in the development of water quality for plant production. Demonstrate the ability to perform common tests to evaluate water quality factors including pH, hardness, ammonium, nitrate, nitrite, dissolved oxygen, and ammonia levels. (TN Reading 3; TN Math N-Q)

22) Analyze the effects of environmental conditions on aquatic plant and animal life. Adjust water quality factors by using quantitative reasoning and appropriate units to calculate proper formulations of chemicals based upon label directions. (TN Reading 3; TN Math N-Q; TN Biology I 2, TN Biology II 2)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 4, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN Biology I: Tennessee Science: Biology I, standards 1, 2, 3, 4.~~
- ~~TN Biology II: Tennessee Science: Biology II, standards 1, 2, 4, 5, 6, 7.~~
- ~~TN Ecology: Tennessee Science: Ecology, standard 6.~~
- ~~TN Environmental Science: Tennessee Science: Environmental Science, standards 2, 4, 7.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards BS and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Greenhouse Management

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5954
Prerequisite(s):	*Principles of Plant Science and Hydroculture* (6119)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the third course in the *Horticulture Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Worker Protection Standard (WPS) for Agricultural Pesticides
Dual Credit or Dual Enrollment Opportunities:	A statewide dual credit challenge examination exists for this course for students to earn dual credit at Tennessee public postsecondary institutions that offer agriculture. For more information, please visit http://www.tn.gov/education/opca/.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/ Training:	While not required to teach the course, teachers who use a greenhouse facility or an outdoor lab (cold frame, nursery, etc.) that uses any type of chemical (with an EPA label) must have the Commercial Pesticide Applicators License for C10 and C15.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Greenhouse Management is an applied-knowledge course designed to prepare students to manage greenhouse operations. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills

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needed to prepare for further education and careers in horticulture production. Greenhouse Management is a dual credit course with statewide articulation. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee state standards for Biology I and Biology II, as well as National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*~~

Program of Study Application

This is the third course for the *Horticulture Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

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Course Standards

Greenhouse Industry Introduction

1) Analyze the global nature of the horticulture industry and assess the economic impact and technological advancements associated with greenhouse production practices. Create a timeline to summarize the history and development of the greenhouse production industry, citing specific textual evidence. ~~(TN Reading 1, 2; TN Writing 4)~~

2) Accurately maintain an activity recordkeeping system and apply proper financial recordkeeping skills as they relate to a greenhouse industry. Demonstrate the ability to analyze records by generating reports and completing related applications (i.e., employment application, efficiency reports, SAE applications, and profit and lost statements). ~~(TN Reading 9; TN Writing 2, 9)~~

3) Apply the concepts of occupational safety and industry safety prevention and control standards by interpreting information from industry manuals.
   a. Assess the purpose of worker protection standards and obtain the worker protection standards student industry certification.
   b. Review common laboratory safety procedures for tool and equipment operation in horticulture laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.
   ~~(TN Reading 3)~~

Greenhouse Design, Construction, and Components

4) Describe characteristics of successful greenhouses and create a list of factors for planning and designing greenhouse facilities. Factors must include physical location, market potential, utilities, climatic conditions, and production goals. ~~(TN Writing 4)~~

5) Classify greenhouse structures by comparing and contrasting greenhouse construction materials, including but not limited to frames, coverings, and glazing materials. Justify selection

of greenhouse construction materials based on cost effectiveness, stability, maintenance, and function. (TN Reading 8, 9; TN Writing 9)

6) Create an annotated model representing research-based practices in greenhouse planning and design and justify the process outlined in the model. The design must include at least the following items: structure materials, layout, lighting, bench arrangements, traffic flow, and physical location. (TN Reading 7; TN Writing 4, 8)

7) Compare general maintenance and upkeep requirements for a variety of greenhouses in relation to the type of structure and associated systems. Create a checklist of prescribed maintenance, preventative maintenance, monitoring, and troubleshooting schedules for greenhouse facilities and equipment. Demonstrate the mechanical skills needed for the general maintenance and repair of greenhouses and associated systems (such as basic wiring, plumbing, and general construction). (TN Reading 2, 3; TN Writing 4, 8)

Growing Media

8) Compare and contrast the attributes of growing mediums. Write an informative essay to describe the major components of soil, and identify basic physical and chemical characteristics of soil including structure and texture. (TN Reading 9; TN Writing 2)

9) Identify and provide written justification to describe the effects of soil and soilless composition (pH, organic matter content, and mineral content) on plant health and growth. Perform basic soil sampling and testing techniques and interpret test data to formulate corrective actions as needed. (TN Reading 1, 3; TN Writing 7, 9; TN Math S-ID)

10) Explain the principles of media preparation; develop a check sheet to guide media preparation. Describe the purpose, methods, and importance for sterilizing media. Compare and contrast the cost effectiveness of premix and personal mix media to soil media. (TN Reading 7; TN Writing 8)

Plant Structure, Function, and Growth

11) Apply concepts of scientific taxonomy and industry-specific terminology in distinguishing different species and types of plants. Create a visual chart, brochure, or fact sheet that identifies common plant species used in greenhouse production by classification, care, and use. (TN Reading 4)

12) Research the basic plant structure components and create an illustrative plant model to identify and differentiate among components. Demonstrate a working knowledge of plant physiology, including:
   a. The relationship between form and function for major plant structures
   b. The anatomical and physiological differences of specific plant species
   (TN Biology II 7)

13) Select relevant technical information to analyze and support claims regarding the relationships between light, temperature, and water on plant growth. Draw conclusions about the interrelationships between plant life processes (such as photosynthesis, respiration, and transpiration), plant growth, and maintenance. (TN Reading 8; TN Biology I 2; TN Biology II 7)

14) Compare and contrast current industry approved methods to regulate plant growth including, but not limited to, environmental, physical, genetic and chemical. Demonstrate in a live setting or in a presentation the ability to apply the best growth regulator to specific plants to obtain selected outcomes. (TN Reading 3, 8, 9; TN Biology II 7)

Plant Nutrition

15) Analyze the nutrient requirements of plants and assess the importance of the 17 essential plant nutrients for plant health. Identify the chemical and biological processes needed to make nutrients available for growth and maintenance, and distinguish among nutrient deficiency and toxicity signs and symptoms in plants. (TN Biology II 7)

16) Research case studies to cite specific textual evidence determining the significance of safety hazards associated with fertilizer use. In an informative essay, justify the use of different precautions for the prevention or management of hazards and evaluate the efficacy of prevention measures. (TN Reading 1, 8, 9; TN Writing 2, 4, 7, 9)

17) Identify the basic types of fertilizers and their applications for greenhouse production crops. Differentiate the effects of fertilizer ratios on plant growth and health to hypothesize possible outcomes of each ratio. Calculate proper formulations of fertilizers based upon label directions using systems of equations. Demonstrate in a live setting or in a presentation the ability to follow fertilizer label procedures precisely as they pertain to selection, handling, application, storage, and disposal. (TN Reading 3; TN Math N-Q, A-CED)

Plant Propagation

18) Differentiate between the methods of sexual and asexual plant propagation by summarizing valid research. Compare and contrast the different techniques of propagation, explaining advantages and disadvantages of each in an informative text. Conduct at least the following: cutting, budding, layering, sowing, germination rate calculation, and seed viability. (TN Reading 2, 8; TN Writing 4, 9)

Environmental Control Systems

19) Assess the procedures required for producing multiple commercial plant species in a controlled environment, and apply these procedures to produce a variety of specific greenhouse crops. Evaluate environmental factors that affect greenhouse crops to justify management methods. (TN Reading 2; TN Writing 4)

20) Evaluate the greenhouse climate and recommend the proper climate control equipment to maintain an optimum growing climate, including but not limited to ventilation, humidifiers, heating, cooling, and shading. Provide written justification for each recommendation. (TN Writing 1, 4).

21) Demonstrate effective methods to meet water requirements for healthy plant growth. Examine and explain how water pH influences plant growth. Research from multiple technical texts the function and operating principles of greenhouse irrigation systems (such as misting, drip, and

overhead systems) to meet watering requirements for the purposes of maintaining optimum moisture level for a variety of plants. (TN Reading 3; TN Writing 8; TN Biology II 7)

Diseases, Disorders, and Pests

22) Determine the economic and aesthetic impact of plant diseases, disorders, and pests. Identify and diagnose the symptoms of common plant diseases, disorders, and pests, and summarize methods of prevention, treatment, and control by drawing evidence from informational texts and relevant scientific literature. (TN Writing 2, 9; TN Biology II 7)

23) Identify the types of pesticides and their applications for greenhouse production. Research the safety hazards associated with pesticide use for multiple greenhouse pesticides. Calculate proper formulations of pesticides based upon label directions for specific pests by creating systems of equations that describe numerical relationships. (TN Reading 1; TN Writing 1, 4, 7, 9; TN Math N-Q, A-CED)

24) Demonstrate in a live setting or in a presentation the ability to follow pesticide procedures precisely according to label and safety guidelines, including selection, handling, personal protective equipment (PPE), application, storage, and disposal. (TN Reading 3)

25) Evaluate the basic principles and assess the overall effectiveness of integrated pest management (IPM) for controlling greenhouse pests and diseases. Compare with traditional chemical controls.

Hydroponic Applications

26) Examine the roles of hydroponic systems in greenhouse crop production. Describe essential elements of hydroponic systems; explore recent trends and advancements to design a hydroponic system for a specific greenhouse crop. (TN Reading 7; TN Writing 8)

27) Apply basic principles of hydroponics to compare hydroponic and soil-based growing methods for providing nutrients to plants. Summarize the advantages and disadvantages of using soilless media systems to evaluate the efficacy for specific crops. (TN Reading 7; TN Writing 8)

Greenhouse Business Management

28) Debate laws and regulations affecting horticulture businesses. Demonstrate the use of general business and recordkeeping skills necessary to manage a horticultural business, including but not limited to marketing, advertising, product displays, scheduling, inventory control, merchandise handling and profit and loss statements. (TN Reading 1, 9; TN Writing 2, 9)

29) Research, develop, and implement greenhouse production schedules for a representative sampling of greenhouse crops that includes at least the following: plant selection, plant material cost (seed, plug, cuttings), growth media, fertilizers, water, testing kits, pricing guides, profit margin, labor, and other expenses. (TN Reading 3; TN Writing 4; TN Math S-ID, Modeling)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Modeling, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and statistical reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN Biology I: Tennessee Science: Biology I standard 2 may provide additional insight and activities for educators.~~
- ~~TN Biology II: Tennessee Science: Biology II standard 7 may provide additional insight and activities for educators.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards ABS.03, ABS.07, CS, PS.01, PS.02, and PS.03 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Landscaping and Turf Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5951
Prerequisite(s):	*Greenhouse Management* (5954)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Horticulture Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Worker Protection Standard (WPS) for Agricultural Pesticides; Tennessee Certified Nursery Professional Certification
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Description

Landscaping and Turf Science is a applied course designed to provide challenging academic standards and relevant technical knowledge and skills needed for further education and careers in landscape design, maintenance, and turf management. Content includes site analysis and planning, principles of design, and plant selection and care techniques. Upon completion of this course, proficient students will be prepared to pursue advanced study of landscaping and turf science at a postsecondary institution. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, and Tennessee state standards for Biology II, as well as National Agriculture, Food, & Natural Resources Career Cluster Content Standards.*

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the fourth and final course in the *Horticulture Sciences* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Introduction to Landscaping and Turf Management

1) Gather and analyze labor data from sources such as the United States Bureau of Labor Statistics and the Tennessee Department of Labor to predict the employment outlook in landscaping and turf management careers. Summarize the interpersonal, business, and technical skills needed for a career in landscaping or turf management. Develop a resume for a selected occupation that includes documented development of industry-related skills (i.e., work experience, SAE records, and proficiency applications). (TN Reading 2; TN Writing 4, 9)

2) Explain general occupational and horticulture industry safety standards. Identify commonly used machinery and equipment and develop a checklist of associated safety and maintenance procedures. Assess the purpose of worker protection standards, complete required safety tests with 100 percent accuracy, and obtain the worker protection standards student industry certification. (TN Reading 3)

Tree and Shrub Selection and Maintenance

3) Develop illustrative models that identify the basic parts of trees and shrubs. Demonstrate the ability to visually identify and distinguish between common tree and shrub species used for landscaping and describe research-based practices in harvesting, transportation, transplanting, and care. (TN Reading 7; TN Writing 4, 8; TN Biology II 7)

4) Using descriptive text, summarize methods for general care and maintenance of trees and shrubs, including planting, pruning, mulching, and fertilizing techniques. Drawing on research and technical data, justify the importance of site evaluation, preparation, and consideration of hardiness zones in the selection of trees and shrubs. (TN Reading 2, 3; TN Writing 2)

Plant Selection and Maintenance

5) Visually identify and distinguish among common ground cover, vines, and plants used for landscaping. Differentiate function, form, and growth requirements for common perennials, annuals, and biennials.

6) Assess methods for general care and maintenance of ground cover, vines, and plants, including planting, pruning, mulching, and fertilizing techniques. Recommend specific vines and ground covers to solve special landscaping issues, and justify recommendations in an argumentative text citing textual and technical evidence. (TN Reading 2; TN Writing 1)

Turf Grass Selection and Maintenance

7) Cite specific textual evidence to compare and contrast the functions and components of turf grasses of common turf grass species. Demonstrate the ability to visually identify and distinguish between turf grass species and cultivars and compose an argument justifying their applications for specific uses. (TN Reading 1; TN Writing 1, 9)

8) Describe methods for the establishment and maintenance of turf grasses, including soil preparation, installation, water, nutrient and pH needs, and fertilizing techniques, attending to appropriate ratios and calculations. Draw conclusions about the importance of site selection, site preparation, and consideration of hardiness zones in the selection of turf grass species and cultivars. (TN Reading 3, 9)

9) Evaluate and compare special management needs of residential, commercial, and sports turf. Identify management practices and associated equipment requirements for mowing, irrigation and weed, disease, and fungus control for common turf grass species. (TN Reading 1, 3; TN Math N-Q)

Commercial Interior Plantscaping

10) Identify and classify basic ornamental flowers and plants (i.e. potted, cut) used for the commercial interior plantscape, and summarize their propagation, installation techniques, and maintenance requirements, citing applicable technical texts. Drawing on knowledge acquired in previous courses, demonstrate in a live or presentation format the ability to construct an interior display using a variety of plant materials, including but not limited to foliage, flowering plants (both cut and potted), live, and permanent/silk plants. (TN Reading 2; TN Biology II 7)

11) Identify and recommend effective management practices for the interior environment, including light, humidity, growing media, and disease and pest control. Compare and contrast decorative accessory items (containers, planters, water features, permanent/silk plants, live plants) in the interior plantscape. (TN Reading 9)

Pest Management

12) Identify and compare the common landscape and turf grass pests and their respective prevention and control methods. Categorize the basic types of pesticides and describe their application methods, including but not limited to rate, environmental conditions, and reentry times. Using quantitative reasoning and appropriate units, calculate proper formulations of pesticides based upon label directions by creating systems of equations that describe numerical relationships. (TN Reading 3; TN Math N-Q, A-CED)

13) Demonstrate in a live setting or in a presentation the ability to properly mix and apply pesticides precisely, attending to important safety standards, selection, handling, application, storage, and disposal. (TN Reading 3; TN Math N-Q)

Water Management

14) Develop a written resource describing the seven principles of xeriscaping and indications for use in landscapes, citing specific textual evidence. ~~(TN Reading 2; TN Writing 4, 8; TN Math N-Q)~~

15) Examine the various types of water gardens and pools and their applications for landscape enhancement. Develop a customer information packet outlining best management practices to maintain a healthy water garden and pool, addressing at minimum the following considerations: pH, nitrate, dissolved oxygen, algae, pollutants, filter requirements, and feed schedules. ~~(TN Reading 3, 7, 9; TN Writing 2)~~

16) Compare and contrast different irrigation systems and summarize their advantages and disadvantages. Identify irrigation tools and system components and their function or application. Applying basic plumbing principles, calculate the water supply flow rate, head pressure requirements, and pipe and pump size considerations for a water garden, pool, or irrigation system. Identify and demonstrate the plumbing skills required to install irrigation and water features in a landscape or turf setting. ~~(TN Reading 3; TN Math N-Q, A-CED, F-BF)~~

17) Design an irrigation system for a residential landscape and develop a bid presentation that identifies the project timeline, required permits, costs of installation and selected materials. ~~(TN Writing 4; TN Math N-Q, G-MG)~~

Landscape Design

18) Interpret topographical and soil maps to evaluate site suitability for selected landscape plants. Create a site analysis checklist to evaluate a proposed landscape site. ~~(TN Writing 4; TN Math N-Q, G-MG)~~

19) Develop a list of tools and skills necessary for drafting landscape designs, including computer-assisted methods. Demonstrate the use of drafting tools and design equipment to create a basic landscape design. ~~(TN Writing 6; TN Math G-MG)~~

20) Explore landscape design principles to outline the components of a comprehensive landscape design plan. Prepare comprehensive landscape plans using prospective residential and commercial plots and develop a landscape bid package and presentation for each plan. ~~(TN Writing 7; TN Math G-MG)~~

Business Principles of Landscaping and Turf Management

21) Compare and contrast different business models. Create a chart to illustrate the use, advantages, and disadvantages of each. Research successful landscaping and turf grass management businesses locally and use evidence from research to evaluate the skills and resources utilized for successful small business implementation. ~~(TN Reading 7; TN Writing 4, 7, 8)~~

22) Using industry-specific terminology, explain the process for preparing a price estimate for landscape designs and packages. Create a price estimate and develop a presentation to secure a bid on a landscape project. ~~(TN Reading 2, 4; TN Writing 4; TN Math N-Q)~~

23) Demonstrate the ability to interpret and read landscape drawings by measuring and calculating materials needed to execute the plan. Evaluate factors that affect profitability. ~~(TN Reading 3; TN Math N-Q, G-MG, S-MD)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Modeling, Statistics and Probability (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN Biology II: Tennessee Science: Biology II standard 7 may provide additional insight and activities for educators.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards PS and CS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

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Applied Environmental Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6114
Prerequisite(s):	*Agriscience* (5957)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies one credit of laboratory science required for graduation.
Programs of Study and Sequence:	This is the second course in the *Environmental and Natural Resources Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	(048 and 015), (048 and 016), (048 and 017), (048 and 081), (048 and 211), (048 and 212), (048 and 213), (048 and 214), (048 and 414), (048 and 415), (048 and 416), (048 and 417), (048 and 418), (048 and 449), (150 and 015), (150 and 016), (150 and 017), (150 and 081), (150 and 151), (150 and 211), (150 and 212), (150 and 213), (150 and 214), (150 and 414), (150 and 415), (150 and 416), (150 and 417), (150 and 418), (150 and 449), (448 and 015), (448 and 016), (448 and 017), (448 and 081), (448 and 211), (448 and 212), (448 and 213), (448 and 214), (448 and 414), (448 and 415), (448 and 416), (448 and 417), (448 and 418), (448 and 449)
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

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Course Description

Applied Environmental Science focuses on the knowledge, information, and skills related to the fundamental science and management of ecosystems as well as careers, leadership, and history of the industry. This course covers principles of environmental impacts, energy consumption, and ecosystem management. Upon completion of this course, proficient students will be prepared for advanced coursework in the *Environmental and Natural Resources* program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee Biology I, Tennessee Biology II, Tennessee Ecology, and Tennessee Environmental Science, as well as National Agriculture, Food and Natural Resourses Career Cluster Content Standards.*~~

Program of Study Application

This is the second course in the *Environmental and Natural Resources* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resource website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Occupational Awareness & Safety

1) Use local news media, organizational websites, and real-time labor market information to investigate occupations in environmental science. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. ~~(TN Reading 2, 9; TN Writing 4, 7, 9)~~

2) Review common laboratory safety procedures for tool and equipment operation in the environmental and natural resources laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. ~~(TN Reading 3)~~

Studying the Environment

3) Define the scope and impact of contemporary environmental science. Describe the interdisciplinary nature of this field and provide examples of how other sciences such as biology, chemistry, earth science, and physics relate to environmental science. Research scholarly, peer-reviewed academic journals focused on the biophysical environment and identify leading academic and professional organizations publishing results of environmental research. ~~(TN Reading 2, 5; TN Writing 7)~~

4) Define the term *biome* and indicate on a map the major biomes of the world. Develop an annotated graphic that can be used to compare and contrast the climates, seasons, soil characteristics, water availability, and other defining features of each biome. Differentiate between biomes within the following categories: aquatic, grasslands, forest, desert, and tundra. ~~(TN Reading 4, 7; TN Writing 4, 9; TN Biology I 2; TN Biology II 2; TN Ecology 5; TN Environmental Science 2)~~

5) Apply basic business and entrepreneurship principles to plan, set up, operate, or expand an environmental science related Supervised Agricultural Experience (SAE) program. Compare the components of SMART goals in relation to evaluating the success of the program. Accurately maintain the prescribed activity recordkeeping system and apply proper financial recordkeeping skills as they relate to the SAE program. (TN Reading 2; TN Writing 4, 9)

Human Impact on the Environment

6) Using instructional materials and news media, research the evolving impact of humans on the environment, from primitive societies to contemporary civilizations. Synthesize analysis in an explanatory essay or presentation that highlights specific milestones and events, citing textual evidence of both positive and negative impacts. (TN Reading 1, 2; TN Writing 2, 4, 7, 9)

7) Synthesize census data and other resources to compare U.S. population statistics to those of other countries around the world. Specifically examine growth rate, age structure, life expectancy, and total population, among other key parameters. Analyze the factors that impact population growth, and assess the impact of population growth in the U.S. and the world on the following: availability of natural resources, land usage, waste production and pollution, and global economic health. (TN Reading 2, 4, 5, 9; TN Environmental Science 3)

Ecosystems

8) Research the components of an ecosystem. Synthesize findings by developing a glossary of terms essential to the study of ecosystems, defining at least the following: habitat, niche, producers, consumers, and vertical stratification. (TN Reading 4, 5; TN Writing 4, 7, 9; TN Biology I 3; TN Biology II 3; TN Ecology 4; TN Environmental Science 4, 5)

9) Compare and contrast grassland, forest, aquatic, and wetland ecosystems including types and species, and explain how biogeochemical cycles and food webs facilitate the flow of energy and the recycling of matter, supplying examples of species that fulfill key roles in each ecosystem. Illustrate similarities in the structure and life processes of ecosystems despite key differences across types of ecosystems. (TN Reading 5, 9; TN Writing 4, 7, 9; TN Biology I 3; TN Biology II 3; TN Ecology 4; TN Environmental Science 4, 5)

10) Analyze how the abiotic and biotic components of the ecosphere interact with and impact one another. Apply knowledge of these interactions to determine the suitability of an area for different types of development (such as commercial, industrial, and primary residential). Develop a claim about a development issue that impacts a selected ecosphere, supporting the claim with evidence and sound reasoning from research. (TN Reading 2, 5; TN Writing 1, 9; TN Biology I 3; TN Biology II 3; TN Ecology 4; TN Environmental Science 2)

11) Create a graphic and accompanying text illustrating primary and secondary succession in a selected biome. Include a discussion of the pioneer species for that biome. Compare immature and mature ecosystems and discuss indicators that can be observed to determine maturity and quality of the ecosystem. (TN Reading 7; TN Writing 4, 9; TN Ecology 5; TN Environmental Science 2)

12) Citing case studies from news media, academic journals or instructional materials, discuss the importance of biodiversity in an ecosystem. Assess how various land uses might impact biodiversity in a given area. Summarize findings an informational essay on one of the following topics:
    a. Impact of the intentional or unintentional introduction of non-native species to an ecosystem
    b. Threatened and endangered species
    c. Agricultural Best Management Practices that promote biodiversity
    (TN Reading 1, 2; TN Writing 2, 4, 7, 8, 9; TN Biology I 2; TN Biology II 2; TN Ecology 5; TN Environmental Science 2)

Energy Consumption

13) Identify energy resources used in the United States and abroad, distinguishing between renewable and nonrenewable resources. Research the global distribution of energy resources; determine major resource-rich regions and how they intersect with geopolitical boundaries. (TN Environmental Science 4, 5, 7)

14) Synthesize public data from government agencies and news organizations to compare energy consumption in the United States to the energy consumption of other countries. Create a series of graphs and charts to inform an average citizen about energy use trends and statistics, including the percentage of each resource that comes from domestic and foreign sources. Investigate claims made about the political and economic implications of using foreign energy resources, analyzing author's purpose and assess the extent to which the reasoning and evidence provided support the author's claim. (TN Reading 2, 6, 7, 8; TN Writing 4, 7, 8; TN Environmental Science 5, 7)

15) Investigate available print and digital tools for conducting an audit of personal energy use. Compile and analyze self-collected data on total energy use, including transportation, water, and electricity consumption, among others. Create and implement a plan to reduce personal energy use. Compare the usage data after one month of implementing the plan, and discuss key takeaways learned from the project. (TN Writing 4, 7; TN Environmental Science 5, 7)

Managing Ecosystems

16) Research standard methods for monitoring a variety of environmental conditions, including but not limited to air, water, and soil, as well as the biological components of an ecosystem. For each domain, create a fact sheet outlining common tests and procedures and the kinds of information learned from the analysis of test results. Demonstrate at least one procedure for learning about each domain. (TN Reading 2, 3; TN Writing 2, 4, 7; TN Biology I 2; TN Biology II 2; TN Ecology 5; TN Environmental Science 2)

17) Research sustainability as it applies to ecosystems and natural resources. Explain the importance of ensuring sustainability when developing a management plan for a specific resource or ecosystem. Outline the components of a management plan, and summarize best practices for the management of forest, wetland, aquatic, and grassland ecosystems. (TN Reading 2, 5; TN Writing 2, 4, 7, 9; TN Environmental Science 2, 4)

18) Describe the evolution of integrated pest management (IPM) strategies through history. Create a brochure that explains the purpose and principles of IPM. Present specific IPM strategies for controlling common home and landscape pests. Create additional informational sheets for large-scale pest control in a variety of natural and human engineered environments. (TN Reading 2; TN Writing 4; TN Environmental Science 4)

Legal and Civic Responsibility

19) Citing specific legislation and international conventions and treaties, create a timeline depicting the historical development of environmental regulation at the state, national and global levels. For each regulation represented on the timeline, summarize the intended goals and ultimate impact of that regulation. Include legislation related to air, water, toxic substances, wastes, energy resources, and mandated environmental impact studies. (TN Reading 1, 2, 7; TN Writing 4, 7, 9; TN Environmental Science 7)

20) Describe the role of federal, state, and local governments in enforcing environmental legislation. Differentiate between key agencies at each level and justify the need for general regulations of environmental hazards. (TN Reading 2)

21) Choose a current environmental issue and conduct research on environmental and ethical implications for potential solutions. Craft an argumentative essay, developing a claim supporting a specific solution and develop both claim(s) and counterclaim(s) with logical evidence and reasoning. (TN Reading 1, 8; TN Writing 1, 7, 8, 9; TN Environmental Science 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- TN Biology I: Tennessee Science: Biology I standards 2 and 3 may provide additional insight and activities for educators.
- TN Biology II: Tennessee Science: Biology II standards 2 and 3 may provide additional insight and activities for educators.

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- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in activities outlined above should be able to demonstrate fluency in Standards ESS.01, .02, .03, .04, .05, .06; NRS.01, .02, .04, and .05 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Plant and Soil Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5950
Prerequisite(s):	*Applied Environmental Science* (6114)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the third course in the *Environmental and Natural Resources* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual enrollment opportunities available with specific universities, including University of Tennessee at Martin.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Plant and Soil Science is an applied-knowledge course focusing on the science and management of plants and soils, with special attention given to current agricultural practices that support the healthy and sustainable cultivation of major crops. Upon completion of this course, proficient students will have been exposed to a range of careers associated with the science and management of plants and soils and will have developed the essential skills and knowledge to be successful in science- or agriculture-related occupations. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee state

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the third course in the *Environmental and Natural Resources* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

History and Importance

1) Determine the role of plants and soil in maintaining environmental quality. Trace the history of soil conservation in the United States by developing an informational essay or graphic, citing specific historical events that promoted the development of soil conservation methodologies found in academic journals and news media. (TN Reading 1, 2; TN Writing 4, 7, 9)

2) Describe current land management practices for rural, suburban, and urban settings to protect and ensure the quality and quantity of freshwater supply. Conduct a review of a specific municipality to identify existing practices governed by local laws and agency policy. Create a narrative to describe the use of a specific practice, citing specific textual evidence from research. (TN Reading 2; TN Writing 2, 4, 7, 9; TN Biology I 2; TN Biology II 2; TN Environmental Science 4)

3) Use local news media, organizational websites, and real-time labor market information to investigate occupations in plant and soil sciences. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. (TN Reading 2, 9; TN Writing 4, 7, 9)

4) Review common laboratory safety procedures for tool and equipment operation in plant and soil science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

Soil Science

5) Create a model or illustration that depicts the formation of soil. Differentiate between the biological, geological, chemical, and physical factors and processes involved in soil formation. (TN Reading 2, 7; TN Writing 4, 9; TN Environmental Science 1)

6) Communicate understanding of methods for classifying soils by preparing a guide that accurately describes the procedures for each method using domain specific language. Demonstrate the ability to follow methods for sampling and analyzing the following: soil pH, texture, permeability, water holding capacity, slope, chemical analyses, and soil organisms. (TN Reading 1, 2, 3, 4; TN Writing 4, 7, 9; TN Environmental Science 1)

7) Conduct soil profiles, soil analysis, and water availability analysis. Synthesize findings in an argumentative essay. Develop a claim justifying appropriate agricultural, recreational,

conservational, and/or aesthetic uses of specific land areas using valid reasoning and citing specific evidence gathered in analyses. (TN Reading 3; TN Writing 1, 4, 7, 9)

Plant Science and Nutrition

8) Compare and contrast the anatomy and physiology of monocot and dicot plants used for crop production. (TN Reading 2, 5)

9) Create a model depicting the parts and functions of plant cells. Label the structures and describe the functions of plant cell organelles. (TN Reading 2, 4, 7; TN Writing 4; TN Biology I 1; TN Biology II 1, 7)

10) Assess the importance of the 16 (sixteen) nutrients essential to plant growth and development. Identify nutritional deficiencies and disorders, distinguish among signs of nutrient deficiency in plants, make recommendations for appropriate treatments, and prescribe preventative control measures for major agricultural crops, including corn, soybean, cotton, tobacco, hay, pasture, and forest. (TN Reading 2, 5; TN Writing 2, 4, 9; TN Biology II 7)

11) Investigate the use of fertilizers as a source of essential plant nutrients. Compare and contrast the use of organic and chemical fertilizers, assessing claims made by producers and consumers of fertilizer products found in promotional materials, news articles, and academic journals. Calculate fertilizer formulations and perform various methods of fertilizer application for crops, such as erosion controlling crops. (TN Reading 1, 3, 6, 8; TN Mathematics N-Q,)

Agricultural Practices and Environmental Issues

12) Research, compare and contrast traditional, sustainable, and organic agriculture methods and practices. Describe how each method aligns to a specific goal, including but not limited to the following: soil fertility and texture maintenance, adequate soil moisture maintenance, erosion prevention, pollution prevention, and weed, insect, and disease management. Assess the costs and benefits of specific methods and practices. (TN Reading 2, 4, 5, 9; TN Environmental Science 2, 4, 6)

13) Identify major agriculture-related pollutants and isolate practices that contribute to the spread of pollution in both urban and traditional agricultural production environments. Develop a list of best practices, citing technical texts to make recommendations for watering procedures, runoff containment, pest control, and chemical use and disposal in both domestic (home) and agricultural production settings. Prepare informational materials emphasizing the importance of using recommended best practices to reduce pollution. (TN Reading 2, 5; TN Writing 4, 7, 9; TN Environmental Science 4, 6, 7)

14) Compare and contrast alternative methods for maintaining home landscapes using sustainable and/or organic products that will reduce pollution and soil erosion and conserve water and energy. Develop an argumentative essay that develops a claim about the need for a specific practice to maintain a healthy home landscape, developing claim(s) and counterclaim(s) with reasoning and evidence. (TN Reading 5, 9; TN Writing 1, 4, 7, 9; TN Environmental Science 2, 4, 6, 7)

15) Research the use of compost and mulch in improving and rebuilding soils. Create a presentation or resource guide describing various compost methods, including field crop composting, commercial composting, backyard compost piles, vermicomposting, and bokashi. Create a chart that compares the inputs, time investment, quality, and quantity of compost prepared by each method. ~~(TN Reading 2, 4, 7; TN Writing 4, 7, 9; TN Ecology 4, 6; TN Environmental Science 4, 6)~~

16) Determine characteristics important in selecting a site for optimal growth of plants and crops in rural, suburban, and urban settings. Describe the factors that influence the economics of crop production in each setting. ~~(TN Reading 2; TN Writing 4, 9; TN Environmental Science 2, 4)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3, 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN Biology I: Tennessee Science: Biology I, standards 1 and 2.~~
- ~~TN Biology II: Tennessee Science: Biology II, standards 1, 2, and 7.~~
- ~~TN Ecology: Tennessee Science: Ecology, standards 4 and 6.~~
- ~~TN Environmental Science: Tennessee Science: Environmental Science, standards 1, 2, 4, 6, and 7.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standard PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Natural Resource Management

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	6117
Prerequisite(s):	*Plant and Soil Science* (5950)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Environmental and Natural Resources Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Hunter Education License
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing local opportunities, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Environmental and Natural Resource Management is an applied course for students interested in learning more about becoming good stewards of our environment and natural resources. This course covers major types of natural resources and their management, public policy, and the role of public education in managing resources, as well as careers, leadership, and history of the industry. Upon completion of this course, proficient students will be prepared for further study and careers as an environmental scientist, conservationist, forester, or wildlife manager. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, as well as National Agriculture, Food and Natural Resourses Career Cluster Content Standards.*

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the fourth and final course in the *Environmental and Natural Resources* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Occupational Awareness & Safety

1) Review common laboratory safety procedures for tool and equipment operation in the natural resource management laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy. (TN Reading 3)

2) Investigate opportunities to expand and diversify a Supervised Agricultural Experience (SAE) program in the area of natural resource management. Demonstrate the ability to prepare basic personal and business records to complete employment, taxes, and SAE related applications, including resume, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements. (TN Reading 3; TN Writing 4; TN Math N-Q)

3) Use local news media, organizational websites, and real-time labor market information to investigate occupations in natural resource management. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required. (TN Reading 2, 9; TN Writing 4, 7, 9)

Managing Water Resources

4) Research the physical and chemical properties of fresh and salt water. Create a chart or graph depicting the essential uses of water, differentiating the amount of water available for human use from that which is inaccessible to humans. (TN Reading 2; TN Writing 4, 9)

5) Research major issues with water quantity and quality impacting global water supply using government reports and news media. Distinguish between point source and non-point source pollution. Debate benefits and costs of various management strategies that have been implemented to solve water quality and quantity issues by creating a rubric that can be used to judge each technique, citing specific textual evidence. (TN Reading 1, 2, 4, 9; TN Writing 4, 7, 9)

6) Evaluate water sources and uses in the local community. Compare and contrast how various water uses (such as agricultural, industrial, power-plant cooling, recreational, and public) impact overall water quality and quantity. Describe how legal issues and water costs impact consumption in an informational narrative. (TN Reading 2; TN Writing 2, 4, 8, 9)

Managing Mineral Resources

7) Research the global distribution of mineral resources. Compare the distribution of various minerals to the regions of the world with the highest demand and/or usage. Investigate current and projected rates of depletion and assess the extent to which reasoning and evidence presented by news media on the consequences of the depletion of readily available reserves support claims or recommendations for management of resources. (TN Reading 8, 9)

8) Describe the four step process of extracting minerals for human consumption (locating a mineral deposit, mining the mineral, processing/refining the mineral, and using the mineral to make a product) using domain-specific words and phrases. Develop an argument about the environmental impact of one, or more, steps in the process, supporting claim(s) and counterclaim(s) with valid evidence and reasoning from research. (TN Reading 2, 4; TN Writing 1, 4, 7, 9)

9) Using the Copper Basin Mine in Tennessee as an example, research claims made about the environmental impact of the mining operation and the methods and processes that have been used to restore the land to its present state. Prepare a presentation of lessons learned from Copper Basin, or another major mining site in modern or contemporary times, citing specific textual evidence that supports or refutes investigated claims. (TN Reading 5, 8; TN Writing 4, 6, 9)

Managing Plant and Animal Resources

10) Apply concepts of scientific taxonomy and industry-specific terminology to distinguish different species and types of plants (such as trees, grasses, legumes, food crops). Create a graphic illustration or fact sheet that compares and contrasts common plant species used in the management of environmental and natural resources by classification, care, and use. (TN Reading 4, 7)

11) Using information presented by local, state, and national government agencies, prepare a presentation on the importance of fish and wildlife as it pertains to such topics as ecosystem stability, genetic reserves, and medicinal, agricultural, aesthetic, recreational, and industrial uses. (TN Reading 2, 5; TN Writing 4, 6, 8, 9)

12) Investigate research-based practices in wildlife management and conservation used by governmental agencies and non-profit organizations dedicated to wildlife preservation. Compose a persuasive essay justifying the use of one such practice (including but not limited to carrying capacity, population control, and habitat management), and make recommendations for scaling the practice to vulnerable regions or habitats, citing specific textual evidence to develop reasoning. (TN Reading 2; TN Writing 1, 4, 7, 9)

13) Using news media and academic journal articles, research the accidental or intentional introduction of exotic species into an environment. Citing specific textual examples, describe the environmental and economic impact associated with their introduction, including the management and eradication of exotic plant and animal species. (TN Reading 1; TN Writing 7, 9)

14) Research, discuss, and evaluate the effects of fish and game laws and their enforcement on maintaining sustainable wildlife populations. Complete and pass student certification program(s) for appropriate fish and game certification (i.e. Hunter Education, National Archery in the Schools Program (NASP), Boating Safety, and/or ATV Safety). Compare and contrast specific case studies describing both successful and failed legislation. Analyze how ecological principles are used to inform game management regulation by investigating environmental challenges a specific law is meant to address. Describe unique issues that arise in managing migratory species. (TN Reading 2, 6)

Managing Land Resources

15) Create a presentation to defend the need for public, state, and federal lands and forest resources, including but not limited to forests, resource areas, wildlife refuges, parks, and wilderness preservation areas, developing claim(s) and counterclaim(s) with valid reasoning and evidence. Describe the increasing pressures being placed on the agencies managing these lands to open them for various forms of development, citing specific examples from news media. (TN Reading 1; TN Writing 1, 4, 6, 9)

16) Explain the importance and impact of state park systems, and justify the use of tax dollars to support them. Differentiate between state parks and state natural areas, their uses, and the ways each are managed.

17) Compare and contrast various forest management methods for monitoring ecosystems, harvesting trees, protecting forests from pathogens and insects, managing fire, managing wildlife, and implementing sustainable forestry practices. Draw conclusions about important wildlife management practices after evaluating case studies of recent natural disasters, such as large wildfires in the western United States, citing specific textual evidence. (TN Reading 1, 2, 9; TN Writing 4, 9)

18) Describe, in detail, the thirteen components required in developing an environmental forestry stewardship plan, including how the components relate to, and impact, one another. Develop, edit, and revise an environmental forestry stewardship plan for a specific plot of land with peer reviews. (TN Reading 2, 5; TN Writing 2, 4, 5, 7, 9)

19) Referencing maps that indicate the distribution of the world's rangeland resources, create informational materials that describe the characteristics of rangeland vegetation, the concept of carrying capacity, and the consequences of overgrazing. Based on this research, assess the general quality of the world's rangelands, and outline specific strategies for their management. (TN Reading 7, 9; TN Writing 2, 4, 7, 9)

Impact of Technology on the Management of Natural Resources

20) Research the application of geographic information systems (GIS) and global positioning systems (GPS), including GIS software, GPS receivers, data acquisition, and spatial analysis of data, to solve problems and increase efficiency in the management of natural resources. Develop an informational text explaining the process of how GIS and GPS are used in the environment and natural resource industry. (TN Reading 2; TN Writing 2, 4, 7, 9)

21) Compare and contrast the types and functions of precision and advanced technologies (such as GIS, GPS, and unmanned aerial vehicles) available to the agriculture industry. Citing technical data and academic research, debate the legal, ethical, and economic impact of using emerging technologies to improve efficiency and efficacy within the environment and natural resource industry by making a claim about the implications of technology use, developing it with reasoning and evidence from the text. (TN Writing 1, 9)

Policy and Governance

22) Compare and contrast Tennessee policies and regulations pertaining to natural resource preservation and management with those of the federal government and international organizations such as the World Wildlife Fund (WWF). Articulate the United States' responsibility to cooperate with the global community to solve issues related to natural resource quality and quantity. (TN Reading 2, 7; TN Writing 1, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards ESS.01, .02, .03, .04, .05, .06; NRS.01, .02, .04, and .05 at the conclusion of the course.
  P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Supervised Agricultural Experience (SAE)

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	5964
Prerequisite(s):	*None*
Credit:	½ credit each year, up to a maximum of 2 credits per student
Grade Level:	9-12
Graduation Requirements:	This course satisfies ½ credit of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Programs of Study and Sequence:	This course can be used to supplement all Agriculture, Food, & Natural Resources programs of study and is designed to evolve with a student through high school.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

A *Supervised Agricultural Experience* (SAE) is a structured experiential learning opportunity that takes place in a setting outside of regular school hours. Individual LEAs can choose whether or not to offer credit, provided participating students demonstrate mastery of the standards outlined below. SAEs allow students to experience the diversity of agriculture and natural resources industries and to gain exposure to agricultural-related career pathways. SAEs require a documented formal project scope, accurate recordkeeping, and student advisor supervision. The following SAE standards align to the

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Program of Study Application

This course can be used to supplement all AFNR programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Agriculture, Food, & Natural Resources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Principles of Supervised Agricultural Experience (SAE) Programs

1) Examine the general philosophy and objectives of SAE programs. Identify and describe the types of SAEs, their applications, and benefits. Types of offerings include:
    a. **Exploratory**: Learn about the big picture of agriculture and its many related careers
    b. **Research/Experimentation and Analysis**: Conduct research and analyze information to discover new knowledge
    c. **Ownership/Entrepreneurship:** Plan and operate an agriculture-related business
    d. **Work-Based Learning (WBL) Placement or Internship**: Work (paid or unpaid) for a business or individual

2) Choose a specific project or WBL placement to build knowledge and skills in a particular agriculture area. Articulate how the knowledge and skills learned in a specific SAE program will benefit preparation for agriculture- and natural resources-related careers. Conduct at least 180 hours of research, work, or activities related to the chosen SAE project.

Project Management and Recordkeeping Skills

3) Formulate annual SMART goals for the SAE project or placement and apply the concepts of project planning to monitor and evaluate SAE progress.

4) Accurately maintain a prescribed recordkeeping system and apply proper financial recordkeeping skills as required by the specific project.

Personal and Career Growth

5) Develop personal SMART goals and conduct activities (such as updating a professional resume or joining a professional organization) to work toward individual and career development.

6) Explore and compare local and regional career opportunities from multiple sources such as the United States Bureau for Labor Statistics and the Tennessee Department of Labor and Workforce Development. Identify and develop knowledge and technical skills necessary for selected careers or job shadowing by linking specific attributes to development activities outlined in SAE SMART goals.

Leadership Skills

7) Examine the leadership skills needed for careers in agriculture and natural resources industries and engage youth leadership opportunities to practice and develop effective leadership skills, such as teamwork, decision making, problem solving, critical thinking, and time management.

8) Demonstrate a working knowledge of parliamentary procedure. When appropriate, conduct meetings and facilitate discussions in accordance with Robert's Rules of Order.

Interpersonal and Communication Skills

9) Demonstrate positive interpersonal skills to work effectively with others and maintain successful professional relationships.

10) Demonstrate the ability to communicate effectively with diverse groups and individuals. Compare and contrast elements of formal and informal communication, and demonstrate appropriate written, verbal, and nonverbal communication skills.

11) Develop public speaking skills by planning, preparing, revising, and delivering public presentations about the results and overall impact of the SAE project at local science/agricultural fairs, school activities, and/or participation in career development events.

Occupational Safety

12) Interpret general occupational health and safety standards. Demonstrate appropriate health and safety procedures for agriculture and natural resources activities aligned with SAE project.

Occupational Ethics

13) Identify and discuss occupational ethics, legal responsibilities, and regulatory compliance issues in relation to specific activities and/or careers aligned with SAE project.

Information Literacy

14) Use a variety of methods to assemble and evaluate information for the purposes of technical research, scientific inquiry, and investigation.

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; as appropriate to grade level (page 62).
    - Note: While not directly aligned to specific standards, students who are engaging in activities outlined above should be encouraged by their agriculture instructor to follow expectations for their grade level for reading and comprehending informational texts.

- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; as appropriate to grade level (pages 64-66).~~
    - ~~Note: While not directly aligned to the specific standards, students who are engaging in activities outlined above should be encouraged by their agriculture instructor to follow expectations for their grade level for research and production of discipline-specific formal writing products.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards CS.01, CS.02, CS.03, CS.07, CS.09, CS.10, and CS.11 at the grade appropriate level.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning: Students engaged in activities outlined above should be able to demonstrate fluency in 21st Century Themes, Learning and Innovation Skills, Information and Media Technology Skills, and Life and Career Skills.

Introduction to Agricultural Sciences

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	Steven Gass, (615) 532-2847, Steven.Gass@tn.gov
Course Code(s):	0885
Prerequisite(s):	None
Credit:	N/A
Grade Level:	7-8
Graduation Requirements:	N/A
Programs of Study and Sequence:	This course serves as a middle school primer for all programs of study in the Agriculture, Food, & Natural Resources career cluster.
Aligned Student Organization(s):	FFA: http://www.tnffa.org Allie Ellis, (615) 253-5207, Allie.Ellis@tn.gov
Supervised Agricultural Experience:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	048, 150, 448
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Course Description

Introduction to Agricultural Sciences is a middle school course designed to provide a general introduction to the agriculture, food, and natural resource industry. This course helps students understand the importance of agriculture in daily life by exploring basic principles of agribusiness, agricultural mechanics, animal science, natural resources, and horticulture. Depending on LEA capacity and preference, the course may be tailored for seventh and eighth grades, with the additional option for flexible implementation schedules. Upon completion of this course, proficient students will be prepared for high school coursework in agriculture. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, as well as Tennessee state science standards for grades 7 and 8.**

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This course can serve as an introductory course leading to all programs of study in the Agriculture, Food and Natural Resourecs career cluster. For more information on the benefits and requirements of implementing these programs in full, please visit the Agriculture, Food, and Natural Reources website at https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources.

Course Standards

Agriculture and Society

1) Create an accurate summary of the importance of agriculture in daily life. Identify sources of different types of food and fiber products and depict them in a visual representation.* (TN Reading 2; TN Writing 8)

2) Review the historical importance of agriculture and its role in the formation of the United States. Write an informative essay that identifies the major changes and advancements that have occurred in agriculture over the last 200 years, specifying the societal and economical impacts of these advancements. (TN Writing 2, 4)

3) Explore local career opportunities in agriculture and examine the importance of the agriculture industry to Tennessee's economy. Use local job postings and Tennessee labor and workforce data.*

Agriscience Investigation

4) Draw evidence from informational and technical texts to evaluate the role of scientific investigation in the agriculture industry. Design and conduct an Agriscience Fair project using the scientific investigation process.* (TN Writing 2, 4, 6, 7, 8, 9)

5) Demonstrate in a live setting or in a presentation the ability to follow procedures precisely, attending to special cases or exceptions noted in appropriate materials, to safely utilize agricultural lab equipment. Demonstrate ability to pass a safety test at 100 percent accuracy on all lab equipment.* (TN Reading 3)

Introduction to Agribusiness

6) Identify types of agribusiness and explore the different roles of local and regional career opportunities in agribusiness. Use local job postings and Tennessee labor and workforce data.*

7) Develop a list summarizing fundamental agribusiness skills, including but not limited to:
   a. Leadership roles
   b. Types of organizational structures
   c. Importance of teamwork
   d. Roles of communication
   e. Principles of recordkeeping
   f. Basic public speaking skills

Introduction to Agricultural Mechanics

8) Examine the impact of the agricultural mechanics industry on United States society and the economy at large, addressing technological developments and career options. Produce an informational essay or model (such as a timeline, graphic illustration, or presentation) to illustrate findings. (TN Reading 1, 2; TN Writing 4, 9)

9) Demonstrate conceptual understanding of the following current practices in agricultural mechanics:
   a. Calculate horsepower and explain its importance and uses
   b. Explain the different types of power units
   c. Explain the functions of basic hand and power tools
   d. Demonstrate the safe use and maintenance of basic hand and power tools, including passing a safety test at 100 percent accuracy
   e. Describe common building methods and materials used in the agricultural industry
   f. Appropriately apply unit conversions and calculate acreage, length, and volumes
   (TN Reading 3)

Introduction to Animal Science

10) Investigate local and regional career opportunities in animal science, drawing on information from multiple print and digital resources such as local job postings and Tennessee labor and workforce data.* (TN Reading 8)

11) Compare and contrast small companion and large domesticated animals, synthesizing informational texts, graphic illustrations, and models to describe the following:
   a. Their historical and contemporary roles in society and the agriculture industry specifically
   b. The social and economic implications for maintaining animal health
   c. Common domesticated breeds and their uses in society
   (TN Reading 1, 9; TN Writing 2, 9)

12) Review illustrative models of major animal body systems (skeletal, muscular, respiratory, digestive, nervous, integumentary, urinary, reproductive) in conjunction with technical information from scientific texts to establish a basic knowledge of animal anatomy and physiology. (TN Reading 5; TN Writing 9)

Introduction to Environmental and Natural Resources Systems

13) Compare and contrast information gathered from a variety of sources to identify local and regional career opportunities in environmental and natural resources systems. Use local job postings and Tennessee labor and workforce data.*

14) Draw conclusions about the interrelationships among plants and animals, citing specific textual evidence to justify conclusions. Identify native wildlife species and describe their environmental and economic impacts in Tennessee, incorporating visual representations such as diagrams or models. (TN Reading 1; TN Science Grade 7: 2, 5; TN Science Grade 8: 2, 5)

15) Explore the basic principles of soil science by analyzing soil structure and formations. Write recommendations for basic methods of soil conservation, citing evidence from news articles, academic journals or agriculture texts. (TN Reading 1, 2; TN Writing 4, 9)

16) Analyze visual representations (charts, diagrams, tables) to summarize important connections and distinctions concerning the flow of energy in ecosystems. (TN Writing 2; TN Science Grade 7: 3, 7; TN Science Grade 8: 3, 7)

17) Identify the types of pollution found in air and water. Citing evidence from academic journals and news articles, determine pollution sources and the general effects of pollutants on the environment. (TN Reading 1, 2)

Introduction to Horticulture

18) Compare and contrast information gathered from a variety of sources to identify local and regional career opportunities in horticulture using local job postings and Tennessee labor and workforce data.* (TN Reading 8)

19) Examine illustrative models of plants to differentiate basic plant structures. Describe how form and function of structures are related. Explain components and processes involved in plant reproduction and growth. (TN Reading 2; TN Science Grade 7: 2; TN Science Grade 8: 2)

20) Analyze the relationship between soil quality and plant health and growth, including impact of pH, organic matter content, and mineral content. (TN Reading 2; TN Science Grade 7: 2)

21) Describe the general characteristics of common plants used in food production, greenhouse, landscaping, and turfgrass applications.

22) Explore basic concepts of sustainable agriculture by researching general principles of aquaculture and hydroponics. Citing relevant research, write an informative essay detailing sustainable practices in aquaculture and hydroponics and their contributions to society. (TN Reading 2; TN Writing 2, 7)

Implementation Notes

Implementation options for eighth grade

*Marked areas to be taught in nine-week rotation format.

Implementation options for seventh grade

Depending on the needs of faculty and students, seventh grade instructors may elect to follow the implementation suggestion for the eighth grade nine-week rotation format. Seventh grade instructors may also choose to concentrate on specific content areas that have unique connections to their district or region, which can provide for a more relevant, customized experience for students.

Standards Alignment Notes

**References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects grades 6-8 (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 7, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects grades 6-8 (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 1, 3, 5, and 10 at the conclusion of the course.~~
- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- ~~TN Science Grade 7: Tennessee Science Grade 7 standards 2, 3, 5, and 7 may provide additional insight and activities for educators.~~
- ~~TN Science Grade 8: Tennessee Science Grade 8 standards 2, 3, 5, and 7 may provide additional insight and activities for educators.~~
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards:
  - Note: While not directly aligned to one specific standard, students engaged in activities outlined above should be able to demonstrate fluency in Standards AS.01 and PS.01 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Fundamentals of Construction

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6073
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the first course in the *Residential & Commercial Construction, Structural Systems,* and *Mechanical, Electrical, & Plumbing (MEP) Systems* programs of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER Core Curriculum.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	501, 502, 522, 523, 524, 527, 532, 553, 554, 555, 556, 567, 575, 580, 584, 585, 592, 598, 701, 702, 703, 705, 706, 707
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Fundamentals of Construction is a foundational course in the Architecture & Construction cluster covering essential knowledge, skills, and concepts required for careers in construction. Upon completion of this course, proficient students will be able to describe various construction fields and outline the steps necessary to advance in specific construction careers. Students will be able to employ tools safely and interpret construction drawings to complete projects demonstrating proper measurement and

Approved January 30, 2015; Amended April 15, 2016

application of mathematical concepts. Standards in this course also include an overview of the construction industry and an introduction to building systems and materials. Students will begin compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in their selected program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is the foundational course in the *Residential & Commercial Construction, Structural Systems,* and *Mechanical, Electrical, & Plumbing (MEP) Systems* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working conditions. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6; NCCER 00101-09)~~

2) Define and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4; NCCER 00101-09)~~

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. ~~(TN Reading 3, 4; NCCER 00101-09, 00109-09)~~

History of Architecture & Construction

4) Investigate the evolution of architecture and construction across a variety of civilizations throughout history. Identify major architectural innovations, such as technological advances in materials or construction processes. Create an annotated timeline or visual graphic illustrating significant time periods in the development of construction. ~~(TN Reading 2, 4, 7; TN Writing 2, 9)~~

Introduction to the Construction Industry

5) Drawing on resources from textbooks, websites, and research centers such as the National Center for Construction Education and Research (NCCER), analyze the organization of the modern construction industry. Distinguish among the various personnel involved in the industry and explain the roles of each in the construction process, including but not limited to the owner, developer, architects, engineers, building officials, contractors, suppliers, unions, and professional craftsmen. For example, create a written report or infographic describing the basic steps of traditional building delivery for a construction project (from pre-design to post-construction), outlining who and what is involved in each step. (TN Reading 1, 2, 4, 5, 7; TN Writing 2; NCCER 44101-08)

6) Research basic regulations affecting today's construction industry.
    a. Investigate and report on the process for securing a building permit for a selected location in the community. (TN Reading 2, 3, 4; TN Writing 2)
    b. Explain what a building code is and where to find published local building codes. Write persuasively to defend why a particular building code is necessary. (TN Reading 2, 3, 4; TN Writing 1)

7) Investigate the social, economic, and environmental impact of construction work at the local, national, and global levels. Analyze current and emerging trends in the construction industry such as LEED certification and green building design, critically examining each source consulted for its validity and reasoning. Integrate findings into a written summary; for example, write an informative essay on how the implementation of green construction practices (such as preventing waste and recycling waste) affects the environment and cost of a project. (TN Reading 2, 4, 8; TN Writing 2, 8, 9)

Career Exploration

8) Research the major professions and trades within construction, such as electrician, carpenter, mason, plumber, HVAC technician, cost estimator, and construction manager. Produce a chart or other graphic detailing the aptitudes and training needed for at least three careers of interest. For example, outline the typical steps needed to become a journeyman electrician, such as completing postsecondary training and obtaining on-the-job training through an apprenticeship, and devise a tentative career plan to reach employment goals. (TN Reading 1, 2, 4, 7; TN Writing 2, 9)

9) Evaluate jobs data and employment projections in the construction industry from sources such as O*Net OnLine, synthesizing findings from each source. Determine areas of largest growth and discuss the significance of construction to the national and global economy. Articulate why construction is considered a STEM field, citing the specific knowledge, skills, and abilities required to be successful in a variety of construction occupations. (TN Reading 1, 2, 4, 7; TN Writing 7, 9; TN Math S-ID)

Introduction to Measurement

10) Use physical measurement devices typically employed in construction to complete accurate field measurements. Determine the appropriate units and record accurate measurements of lengths

and angles. Tools should include, but are not limited to: fractional rule, metric rule, measuring tape, architect's scale, engineer's scale, dial caliper, micrometer, protractor, and square. (TN Reading 3; TN Math N-Q; NCCER 00102-09)

11) Interpret given linear and angular dimensions to accurately set up layouts to complete a project. For example, use an architect's scale to measure distance on a construction drawing, and then use a measuring tape to lay out cuts in dimensional lumber to an accuracy of 1/16 inch. (TN Reading 2, 3; TN Math N-Q; NCCER 00102-09)

Construction Math

12) Apply mathematics concepts to solve construction problems, distinguishing which principles apply to a given construction problem. Concepts should include, but are not limited to:
    a. Operating with whole numbers, fractions, and decimals. (TN Math N-Q; NCCER 00102-09)
    b. Performing conversions between fractions, decimals, and percent. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch. (TN Math N-Q; NCCER 00102-09)
    c. Working with units such as feet, inches, meters, centimeters, and millimeters, and determining appropriate units for a given construction task. For example, determine how many pieces of 2 ft. 4 in. PVC pipe may be cut from a 10 ft. piece and how much pipe will be left over. (TN Math N-Q; NCCER 00102-09)
    d. Calculating the area of two-dimensional spaces. Calculating surface area and volume for three-dimensional objects employing related geometric terminology. (TN Math G-GMD, G-MG; NCCER 00102-09)
    e. Performing proportionate reasoning to estimate quantities. (TN Math N-Q)
    f. Using basic rules of right triangles, such as the Pythagorean Theorem, to find missing lengths. (TN Math G-SRT)

Tools & Equipment

13) Accurately identify a wide range of hand and power tools used in the construction trades, such as striking tools, cutting tools, torque producing tools, leveling and squaring tools, grinding and shaping tools, clamping tools, and pulling and lifting tools. Explain when each is used and describe the characteristics that make each appropriate for a given task. (TN Reading 2, 3, 4)

14) Assess a variety of situations requiring the use of hand tools, power tools, and equipment. Select the proper tool and accessories, critique the readiness of the tool, use the tool to accomplish the desired task, and then return the tool and accessories to their proper storage. For example, demonstrate the ability to safely use a crosscut saw to cut a straight square to specified dimensions on dimensional lumber. (TN Reading 3; TN Math N-Q; NCCER 00103-09, 00104-09)

Introduction to Building Systems and Materials

15) Compare and contrast the properties and uses of basic construction materials employed in building construction processes, such as aggregates, asphalt, concrete, steel, wood, and masonry materials. (TN Reading 4)

16) Distinguish between the various types of fasteners commonly used in construction, such as nails, screws, and bolts, by creating a visual display outlining the properties and uses of each type. Demonstrate the ability to accurately select and install the appropriate fastener in a variety of situations. (TN Reading 2, 3, 4, 7; TN Writing 2; NCCER 27102-13)

17) Using graphic illustrations and supporting text, identify and describe major building systems (i.e. foundation, structural, mechanical, electrical, and plumbing systems) to establish a basic knowledge of their purpose, structure, and function. Discriminate between the different types of construction drawings related to these systems, analyze how those drawings are organized, and interpret the common symbols used in each. (TN Reading 2, 4, 5, 7, 9; NCCER 00105-09)

Construction Drawings & Specifications

18) Inspect and interpret construction drawings, diagrams, and written specifications for construction projects. Explain how pictorial representations relate to a physical layout. Use an architect's scale and the given dimensions on a construction document to determine an unknown dimension. For example, interpret electrical schedules and single-pole or three-way light switch symbols in electrical plans to determine the types, quantities, and exact physical locations of the light switches to be installed in a construction project. (TN Reading 1, 2, 4, 6, 7; NCCER 00105-09)

19) Describe the purpose of specifications in a construction document set. Examine how specifications are organized according to the Construction Specifications Institute's (CSI) *Master Format*. Select an assortment of building products and classify them according to *Master Format*. Analyze actual specifications and create a list of items commonly included in a specification. Following CSI models and format, write a specification for a given component of a building project. (TN Reading 1, 3, 4, 5, 6; TN Writing 2, 4, 8, 9; NCCER 44105-08)

20) Create two-dimensional scale drawings using accepted dimensioning rules and measurement systems. For example, as part of a project to build a simple structure, develop the complete drawings that specify the dimensional details for each step of the construction process, annotating all drawings such that another person could replicate the work. (TN Reading 3, 4; TN Math N-Q, G-MG)

Course Project

21) Interpret construction drawings to determine the correct materials, tools, and equipment needed to complete a basic construction project. Plan and implement the steps needed to complete the project, attending to precise details and employing safe practices throughout. For example, read and interpret a technical document to build a simple tool box. (TN Reading 1, 3, 7; NCCER 00105-09)

Portfolio

22) Compile important artifacts to create a portfolio connecting personal career preparation to concepts learned in this course. Continually update and reflect upon artifacts produced, including written products, to strengthen work samples over time, using technology where appropriate. (TN Writing 4, 5, 6)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry, Statistics and Probability (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- NCCER Curriculum: [National Center for Construction Education and Research](#)
  - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for the NCCER Core Curriculum and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Residential & Commercial Construction I

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6162
Prerequisite(s):	*Fundamentals of Construction* (6073)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the second course in the *Residential & Commercial Construction* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER Construction Technology.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	580 OR a minimum of three of the following endorsements: 522, 523, 524, 527, 598, OR a minimum of three of the following endorsements: 701, 702, 703, 706, 707
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Residential & Commercial Construction I is the second course in the *Residential & Commercial Construction* program of study intended to prepare students for careers in construction by developing an understanding of the different phases of a construction project from start to finish. Upon completion of this course, proficient students will be able to demonstrate knowledge and skill in the earlier phases of building construction, including site layout, foundation systems, concrete, framing systems, and

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electrical systems. Students will be able to perform concrete work; frame walls, ceilings, and floors of a structure; and install proper wiring while safely employing tools and interpreting construction drawings to complete projects. Emphasis is placed on demonstrating proper measurement and application of mathematical concepts. Standards in this course also include principles of the construction industry and business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Physical Science Standards, and the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is the second course in the *Residential & Commercial Construction* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working conditions. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Perform a hazard assessment for a given task such as changing the light bulbs in a classroom. Explain the steps necessary to safely perform the task, outlining procedures to follow in the case of an emergency. ~~(TN Reading 3, 4, 6; TN Writing 2)~~

2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. ~~(TN Reading 3, 4)~~

Tools & Equipment

4) For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks,

and then return the tools and accessories to their proper storage locations. For example, demonstrate the ability to safely use a darby or bullfloat to level a concrete surface and effectively clean and store the tool. (TN Reading 3; TN Math N-Q)

Career Exploration

5) Referencing data from U.S. Department of Labor and other sources, explain an apprenticeship. Write persuasively to describe the benefits of the apprenticeship approach of on-the-job training paired with related training for individuals seeking construction careers. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. (TN Reading 1, 7, 8; TN Writing 1, 8, 9)

6) Research apprenticeships and postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer construction-related programs. Write an informative paper or develop an infographic identifying entry requirements for a specific apprenticeship or postsecondary program of study, and the secondary courses that will prepare students to be successful in the program. (TN Reading 1, 3; TN Writing 4, 7)

Construction Industry Principles

7) Investigate and report on the process for determining the zoning regulations for a particular building site. Describe how zone designation and regulations such as setbacks, ground coverage, and maximum height impact the design and placement of a building on a given site, citing findings from the investigation. (TN Reading 2, 3, 4; TN Writing 2)

8) Explain inspection procedures used to enforce building codes during the construction of a residential or commercial building, outlining the roles and responsibilities of the building inspector and the contractor and the intervals at which inspections are performed. (TN Reading 2, 3, 4)

Site Layout

9) Describe the basic procedures by which surveyors create site drawings. Read and interpret a site drawing to determine the steps, personnel, equipment, and materials needed to prepare a site for construction. Relate the site features labeled on the plan to the layout and topography on the actual site. Develop a timeline and action steps needed to complete a site layout. (TN Reading 1, 2, 4, 6, 7; NCCER 68101-09)

10) Apply the appropriate mathematical principles, tools, equipment, and procedures to accurately lay out a site, including:
    a. Estimating distances by employing pacing techniques. (TN Math N-Q; NCCER 68101-09)
    b. Completing precise measurements with manual or electronic equipment, using mathematical concepts as necessary, such as converting decimal feet to feet and inches or applying right triangle rules such as the 3-4-5 rule. For example, in the process of staking the corners of a building using taping procedures, calculate the diagonal of the building by plugging the length and width of the building into the Pythagorean Theorem.

Then, use the diagonal value to locate the third corner and check the completed layout for accuracy. (TN Reading 3; TN Math N-Q, G-SRT; NCCER 68101-09)

    c. Describing the tools, equipment, and procedures involved in establishing elevations on a site. For example, use a builder's level to determine site and building elevations. (TN Math N-Q; NCCER 68101-09)

    d. Annotating site layout data using proper field note techniques. (TN Writing 4; NCCER 68101-09)

Foundation Systems and Properties of Concrete

11) Draw on construction texts and other technical documents to compare and contrast types of foundation systems and footings. Create a written report or visual description outlining the structure and properties of each type. Describe the conditions, costs, and other factors that influence the decision to use each type of system. (TN Reading 2, 4, 5, 7; TN Writing 2; NCCER 68102-09)

12) Describe the composition of concrete by listing the materials used to make concrete. Analyze the factors that impact the compression strength of concrete, such as the water-cement ratio. Identify additional materials used in concrete construction, such as reinforcement materials and forms. For example, create a comparison chart outlining the materials, forms, and reinforcement used in concrete for a sidewalk versus a bridge. (TN Reading 2, 4, 5, 7; TN Writing 2, 9; TN Math N-Q; NCCER 68102-09)

13) Calculate the total volume of concrete and the specific materials necessary for a given project based on construction drawings and specifications. Use the information to estimate the amount of each material needed to mix concrete for the project. (TN Reading 4, 6; TN Math N-Q, G-GMD, G-MG; NCCER 68102-09)

14) Analyze factors influencing the curing of concrete, such as the weather, moisture, and the use of control joints. For example, write an explanatory text outlining the procedures necessary to ensure concrete cures properly for a given date and location, including procedures to prevent cracking and recommendations for the spacing of control joints. (TN Reading 2, 3, 4, 5; TN Writing 2, 4; TN Math N-Q; NCCER 68103-09)

15) Apply the appropriate tools, equipment, and procedures to safely place concrete and cleanup after a concrete project. Work in teams to safely and properly employ tools and personal protective equipment (PPE), and follow procedures to construct a simple concrete form, place concrete into the form, and strike-off (screed), level, smooth, edge, and joint concrete to finish the project. (TN Reading 3, 4; NCCER 68102-09)

Framing Systems Overview

16) Distinguish among the basic types of wood framing systems, such as platform frames, balloon frames, and post-and-beam frames. Create a chart to define and compare the pros and cons of each, citing examples of when each is used. (TN Reading 1, 2, 7; NCCER 68106-09)

Floor Framing Systems

17) Identify the components which make up a floor frame, analyzing the purpose of and interrelationships among each component and explaining the sequence in which each is constructed. (TN Reading 2, 3, 4, 5; NCCER 68106-09)

18) Read and interpret construction drawings to determine floor system requirements such as the proper girder and joist size for a given span and floor load, and estimate the amount of material needed to frame a floor assembly. (TN Reading 1, 4, 7; TN Math N-Q; NCCER 68106-09)

19) Describe the procedures necessary to fasten sills to the foundation and construct a floor assembly. Apply the appropriate tools, equipment, and procedures to build a floor assembly. Work in teams to install girders, lay out and install floor joists, install bridging and blocking, and apply subflooring. (TN Reading 3; NCCER 68106-09)

Wall and Ceiling Framing Systems

20) Explain the procedure to lay out a wood frame wall, defining and describing the components such as plates, studs, partitions, door and window openings, bracing, and other components. (TN Reading 3, 4; NCCER 68107-09)

21) Read and interpret drawings to determine wall and ceiling frame requirements for a given residential or commercial structure. For example, calculate the length of a stud and estimate the amount of material needed to frame a wall and ceiling assembly. (TN Reading 4; TN Math N-Q; NCCER 68107-09)

22) Work in teams to construct a wall frame and ceiling assembly by implementing required safety techniques, tools, and equipment. Accurately measure and lay out the frame; accurately level and plumb the walls. (TN Reading 3; TN Math N-Q; NCCER 68107-09)

23) Compare and contrast the different tools, procedures, and fastening methods used in steel wall framing versus wood wall framing in building construction. Outline the major similarities and differences in each and write persuasively to provide a recommendation to a client for a specific project. (TN Reading 2, 3, 4; TN Writing 1, 4, 9; NCCER 68107-09)

Electrical Systems

24) Describe how different levels of electrical shock affect the human body. Research current OSHA standards and other regulations specific to electrical systems to identify methods and equipment to reduce the risk of injury due to electrical shock. Drawing on evidence from textbooks and OSHA standards, apply lockout/tagout procedures to ensure safe working conditions. For example, perform a lockout/tagout to prepare to work on an electrical device. (TN Reading 1, 2, 3, 4; TN Writing 9; NCCER 68112-09)

25) Citing technical data, explain the interrelationships among sources of current, voltage, resistance, and power in electric circuits and the units to quantify each (amperes, volts, ohms and watts). Demonstrate understanding of the operation of electrical circuits (series, parallel, and series-parallel circuits) and relate it to the physical laws, such as Ohm's law and Kirchhoff's

law, that govern the behavior of electrical circuits and devices such as the function of resistors in electrical circuits. Accurately apply these physical laws to solve problems. For example, use Ohm's law to calculate the current flow of a circuit for an electric dryer with a given voltage and resistance. (TN Reading 2, 3, 4, 5; TN Math N-Q, A-SSE, A-CED; TN Physical Science 2; NCCER 26103-14)

Construction Drawings & Specifications

26) Inspect and interpret a full set of construction drawings and specifications for a construction project including civil, architectural, structural, mechanical, plumbing, electrical, and fire protection drawings and specifications. Read and interpret different drawing types including plan view drawings, elevation view drawings, section drawings, detail drawings, and schedules. Explain the relationship between different types of drawing and the importance of cross-referencing different types of drawings with one another and cross-referencing drawings with specifications. For example, explain how a floor plan, elevation, and detail drawing may all be used to inform the reader about the layout and material of a given building component, such as a cabinet layout or an exterior wall. (TN Reading 1, 2, 4, 5, 6, 7, 9; NCCER 44105-08)

Business and Project Management

27) Describe strategies used to promote collaboration, trust, and clear communication among internal and external parties on a job site. Practice effective verbal, nonverbal, written, and electronic communication skills for working with colleagues, employers, clients, and other personnel while demonstrating the ability to: listen attentively, speak courteously and respectfully, resolve obstacles in construction, and respond to criticism. For example, assume the roles of a construction business owner and a potential client, listen to the needs of the potential client, and respond to the potential client by email; explain the services provided by the company and the next steps needed to begin the project. Other role playing could include a construction business owner and a potential subcontractor. (TN Reading 2, 3; TN Writing 2, 4; NCCER 00108-09)

28) Describe the components and purpose of a basic contract document for a residential project. Recognize the relationship and responsibilities of various parties to a contract. Write a basic contract for a construction job, such as a carpenter's contract to complete a deck addition for a residential client. (TN Reading 2, 3, 4, 5; NCCER 44105-08)

29) Interpret construction drawings to determine the correct materials, tools, and equipment needed to complete a construction project. Plan and implement the steps needed to complete the project, adhering to inspection procedures and employing safe practices throughout. Draw from print and electronic examples to create and publish a material list, cost estimation, construction schedule, and inspection checklist for a project, applying the components of the documents to the given project. (TN Reading 2, 3; TN Writing 4, 6)

30) Log daily activities completed during a construction project over an extended period of time. Document important facts concisely in a daily report as would a project manager on a jobsite, including daily progress, equipment and materials used, personnel involved, and other work-related activities. Review and revise as appropriate. (TN Reading 3; TN Writing 2, 5, 10)

Portfolio

31) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction*. Continually reflect on coursework experiences and revise and refine the career plan generated in the prior course, using technology where appropriate. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Geometry (pages 58-83).
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Physical Science: Tennessee Science: Physical Science standard 2 may provide additional insight and activities for educators.
- NCCER Curriculum: National Center for Construction Education and Research
  - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will complete modules working toward a certificate of completion for NCCER Construction Technology and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Residential & Commercial Construction II

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6163
Prerequisite(s):	*Residential & Commercial Construction I* (6162)
Credit:	1-2 credits (see Recommended Credit below)
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the third course in the *Residential & Commercial Construction* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER Construction Technology.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	580 OR a minimum of three of the following endorsements: 522, 523, 524, 527, 598, OR a minimum of three of the following endorsements: 701, 702, 703, 706, 707
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Residential & Commercial Construction II is the third course in the *Residential & Commercial Construction* program of study intended to prepare students for careers in construction by developing an understanding of the different phases of a construction project from start to finish. Upon completion of this course, proficient students will be able to demonstrate knowledge and skill in the later phases of building construction including roofing systems, exterior finishing, stair framing systems, masonry

Approved January 30, 2015

systems, and plumbing systems. Students will be able to perform masonry work; frame roofs; install shingles on roofs; apply exterior finishes; and install proper piping for plumbing systems while safely employing tools and interpreting construction drawings to complete projects. Emphasis is placed on demonstrating proper measurement and application of mathematical concepts. Standards in this course also include an introduction to heating, ventilation, and air conditioning systems, principles of the construction industry, and business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Physical Science Standards, Tennessee Physics Standards, and the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is the third course in the *Residential & Commercial Construction* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one credit or two credits, this course can feed into a fourth-level *Construction Practicum* course in which students can apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Recommended Credit

If all standards in the course are covered, the course is recommended for two credits. If only one credit is to be offered, the following two options are recommended:

1 Credit Option A: Exterior

Content	Standards
Safety	1, 2, 3
Tools & Equipment	4
Construction Industry Principles	5, 6
Roofing Systems	7, 8, 9, 10, 11, 12
Exterior Finishing	13, 14, 15, 16
Basic Stair Framing Systems	17, 18
Introduction to Masonry Systems	19, 20
Construction Drawings & Specifications	32, 33
Business & Project Management	34, 35, 36
Portfolio	37

1 Credit Option B: Interior

Content	Standards
Safety	1, 2, 3
Tools & Equipment	4
Construction Industry Principles	5, 6
Plumbing Systems	21, 22, 23, 24, 25, 26
Principles of Electrical Systems	27, 28, 29
Introduction to HVAC	30, 31
Construction Drawings & Specifications	32, 33
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Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working conditions. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures. (TN Reading 3, 4, 6; TN Writing 2, 4)

2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. (TN Reading 3, 4)

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. (TN Reading 3, 4)

Tools & Equipment

4) For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the construction industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency and reduce muscle fatigue for a construction team. (TN Reading 2, 3, 4; TN Writing 1, 7)

Construction Industry Principles

5) Locate and assess the Tennessee Contractor's Licensing Board's website and analyze the policies and requirements for construction work in Tennessee. Explain how such policies impact local construction businesses. (TN Reading 2, 3, 4)

6) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client describing the services provided and explaining the building delivery method used by the company. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4, 8)

Roofing Systems

7) Define and describe the framing components of gable and hip roofs such as the ridgeboard, plates, and types of rafters. For example, create a graphic illustration showing the roles of each component and how they work together in a roof framing system. (TN Reading 3, 4, 7; NCCER 68108-09)

8) Read and interpret drawings to determine roof framing requirements, such as calculating the length of a rafter based on the desired pitch and estimating the materials needed to frame and sheath a roof. For example, use a speed square to lay out a common rafter on a piece of lumber. (TN Reading 2, 3, 4; TN Math N-Q, G-SRT; NCCER 68108-09)

9) Work in teams to construct a roof frame assembly by implementing required safety techniques, tools, and equipment to accurately measure, lay out, construct, and sheath a roof frame. For example, frame a gable roof with an opening. (TN Reading 3; TN Math N-Q; NCCER 68108-09)

10) Compare and contrast different procedures to frame a roof. For example, describe the benefits of using prefabricated trusses in place of framing with rafters on site. Outline the major similarities and differences in each and write persuasively to describe why using either prefabricated trusses or framing with rafters is more beneficial for a specific project. (TN Reading 2, 3, 4; TN Writing 1, 4, 7, 9; NCCER 68108-09)

11) Compare and contrast the materials, methods, and procedures for roofing with fiberglass shingles with other roofing materials such as wood shingles, metal roofing, and membrane-type roofing systems. Perform a cost analysis for a client to help the client choose between two roofing materials for a specific project given the site location, project budget, environmental considerations, and other factors. (TN Reading 2, 3, 4; NCCER 68109-09)

12) Apply the appropriate tools, equipment, and procedures to safely install shingles on a roof including strategies for watertight installation, using quantitative reasoning and geometric formulas where applicable. For example, interpret construction documents to estimate the roofing materials needed to install fiberglass shingles on a gable roof. After preparing the roof with underlayment, flashing, and other preparation materials, install fiberglass shingles. (TN Reading 3; TN Math N-Q; NCCER 68109-09)

Exterior Finishing

13) Examine a wall section drawing for a specific building. Identify, define, and explain the function of each component including wall insulation, flashing, and the structure of the cornice. Draw from textbooks and other resources to annotate the wall section drawing with notes explaining

the purpose of each component. (TN Reading 1, 2, 3, 4, 5, 7; TN Writing 2, 4, 9; NCCER 68110-09)

14) Interpret wall section drawings to safely construct a cornice. For example, accurately measure materials, employ tools, and follow procedures to build a box cornice, checking for accuracy in each step. (TN Reading 3; TN Math N-Q; NCCER 68110-09)

15) Analyze various finish systems used to sheath a building, including but not limited to wood siding, fiber-cement siding, vinyl siding, metal siding, stucco, and masonry veneer finishes. Perform a case study of three different buildings in the community which are sheathed in different ways, hypothesizing why the different materials and methods were selected for each. (TN Reading 2, 3, 4; NCCER 68110-09)

16) Estimate the siding materials needed to cover a building utilizing mathematical principles such as area formulas and quantitative reasoning. Utilize the appropriate procedures, tools, and materials to install various types of siding. For example, identify three siding methods that are commonly used in the area and demonstrate the ability to plan the installation of and install each. (TN Reading 3; Math N-Q; NCCER 68110-09)

Basic Stair Framing Systems

17) Analyze the components of a stair system. Read and interpret construction drawings to determine stair system requirements such as the total rise, number and size of risers, and number and size of treads. Based on stated requirements, estimate the amount of material needed to frame a stair assembly. (TN Reading 2, 3, 4, 5, 7; TN Math N-Q; NCCER 68111-09)

18) Apply the appropriate tools, equipment, and procedures to safely build a small stair unit, demonstrating proper procedures for laying out and cutting stringers, risers, and treads. (TN Reading 3; TN Math N-Q; NCCER 68111-09)

Introduction to Masonry Systems

19) Describe the materials and methods used in modern masonry. Distinguish between masonry units made of clay products (i.e. brick) and masonry units made of concrete (i.e. block), analyzing the composition and structure of common units. Differentiate between the types of masonry construction, such as solid masonry walls, cavity walls, and veneer walls, citing examples of when each is used. Apply the knowledge to examine two different masonry constructions found in the school or community. Create a visual display with supporting text comparing the composition and construction methods of each. (TN Reading 1, 2, 3, 4, 5, 7; TN Writing 2; NCCER 68104-09)

20) Describe and demonstrate the procedures and techniques of basic bricklaying, including preparing mortar, laying a mortar bed, and laying bricks. Apply the appropriate tools, equipment, and procedures to safely mix mortar and properly use a trowel to spread and furrow bed joints and butter head joints. (TN Reading 3, 4; NCCER 68104-09)

Plumbing Systems

21) Study a schematic plan of a typical community sewer system. Citing evidence from a technical description or actual observation of a system, explain how waste moves through a drain, waste, and vent system from the fixture to the environment. Create a graphic illustration to represent the movement of waste from one component to the others in the system. For example, create a basic diagram of how the waste generated by a clean-up sink in the classroom travels to the local sewage treatment plant. (TN Reading 2, 3, 4, 7; NCCER 68115-09)

22) Demonstrate understanding of the specific roles of various plumbing components in a drain, waste, and vent system by sketching a system model. Label the components, and include a written description of the function of each. Be able to describe the physical principles involved such as gravity and pressure. (TN Reading 2, 3, 4, 5, 7; TN Writing 2; TN Physical Science 1; NCCER 68115-09)

23) Analyze the function of a trap by examining a drain, waste, and vent system whose trap has lost its seal. Diagnose and explain the cause and determine the appropriate solution, citing evidence from textbooks or technical manuals in order to justify why the chosen solution is preferable or more effective than another. (TN Reading 1, 2, 4, 5; TN Writing 2, 9; NCCER 68115-09)

24) Determine common requirements found in plumbing codes and explain why the codes are necessary; include the importance of proper plumbing on human health. Examine a case in which poor plumbing contributed to the outbreak of disease in a community. Write an explanatory text to illustrate the problem and describe how it could have been prevented with proper plumbing applications. (TN Reading 2, 4, 5; TN Writing 2; NCCER 68115-09)

25) Compare and contrast the material properties and uses of the various types of plastic and copper piping, including storing and handling, safety issues, and types of fitting and hanging equipment. Describe the factors influencing the decision to use plastic or copper piping in a residence. Demonstrate the ability to select the correct materials, tools, and PPE to complete both plastic and copper piping projects by creating a list of the items needed for a specific installation. For example, for a residential bathroom sink drain, create a list of the materials, tools, and equipment needed to install the drain. (TN Reading 2, 3, 4, 7; TN Writing 4, 9; NCCER 6811-09, 68117-09)

26) Employ tools and procedures to safely measure, cut, ream, and join plastic and copper piping and fittings. For example, accurately measure PVC pipe, use a miter box and handsaw to cut pieces of pipe, ream and chamfer the ends, and join the pipe using solvent cement. (TN Reading 3, 4; TN Math N-Q; NCCER 6811-09, 68117-09)

Principles of Electrical Systems

27) Evaluate and recommend proper electrical hardware for a residential building. For example, for a residential dwelling with a given floor plan and schedule of major appliances, determine the size of the electrical service by referring to the National Electrical Code to select the service-entrance equipment, such as conductors, panelboard, and protective devices. Steps should include: calculating the load for lighting, small appliances, and large appliances; and determining

the number of branch circuits required. Describe the installation rules pertaining to dedicated circuits as applied to various equipment such as ranges, dryers, and HVAC systems. (TN Reading 2, 3, 4, 7; TN Math N-Q; TN Physical Science 2; NCCER 68113-09)

28) Utilize the proper tools, equipment, and procedures to select and safely perform basic installation of device boxes according to drawings, specifications, and code requirements. (TN Reading 3, 4, 6, 9; NCCER 68113-09; 26106-14)

29) Utilizing test equipment such as a voltmeter, inspect and test an electrical wiring system for compliance according to drawings, specifications, and code requirements. (TN Reading 3, 4, 6; TN Math N-Q; TN Physical Science 2; TN Physics 5; NCCER 26112-14)

Introduction to Heating, Ventilation, and Air Conditioning Systems (HVAC)

30) Demonstrate understanding of the principles of heating, ventilation and air conditioning systems. Use graphic illustrations and supporting text to describe the structure and function of each system. (TN Reading 2, 3, 4, 5, 7; TN Writing 2; NCCER 68114-09)

31) Examine the regulations which impact the work of HVAC technicians, such as the Clean Air Act and EPA guidelines. Create a brochure to inform an individual contemplating beginning an HVAC business of these regulations, explaining key considerations and citing resources. (TN Reading 1, 2, 4; TN Writing 2, 4, 9; NCCER 68114-09)

Construction Drawings & Specifications

32) Explain the relationship between construction drawings and specifications. For example, describe how both the construction drawings and specifications provide information about the exterior sheathing indicated for a building. Examine construction drawings and specifications to determine the requirements of the sheathing for a given part of a building, and verify with measurements and other sources as needed. (TN Reading 1, 2, 4, 5, 6, 7, 8; NCCER 44105-08)

33) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI), as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product. (TN Writing 4; NCCER 44105-08)

Business & Project Management

34) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals. (TN Reading 2, 6; TN Writing 2)

35) Perform estimating and scheduling techniques for a long-term project, including calculating material quantities and cost (including tax) and labor cost to complete a bid sheet; scheduling

construction activities using a flow chart; and determining amounts to be charged to the client at various intervals throughout the project. (TN Reading 3, 7; TN Writing 4; TN Math N-Q)

36) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during construction activities as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule. (TN Reading 3; TN Writing 2, 4, 6, 10)

Portfolio

37) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Residential & Commercial Construction I*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses, using technology where appropriate. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Physical Science: Tennessee Science: Physical Science standard 2 may provide additional insight and activities for educators.
- TN Physics: Tennessee Science: Physics standard 5 may provide additional insight and activities for educators.
- NCCER Curriculum: National Center for Construction Education and Research

- o Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will complete modules working toward a certificate of completion for NCCER Construction Technology and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Structural Systems I

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6164
Prerequisite(s):	*Fundamentals of Construction* (6073)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the second course in the *Structural Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER Carpentry.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	522, 575, 580, 592, 706
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Structural Systems I prepares students for careers in residential and commercial carpentry. Upon completion of this course, proficient students will be able to demonstrate knowledge and skill in framing buildings. Students will be able to frame floors, walls, ceilings, roofs, and stairs while safely employing tools and interpreting construction drawings to complete projects. Emphasis is placed on demonstrating proper measurement and application of mathematical concepts. Standards in this course also include principles of the construction industry and business and project management. Students will continue

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compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Physical Science Standards, Tennessee Physics Standards, and the National Center for Construction Education and Research (NCCER) Curriculum.~~*

Program of Study Application

This is the second course in the *Structural Systems* program of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Perform a hazard assessment for a given task such as working on a ladder to install roof framing components. Explain the steps necessary to safely perform the task, outlining steps to take in case of an emergency. ~~(TN Reading 3, 4, 6; TN Writing 2; NCCER 27101-13)~~

2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4; NCCER 27101-13)~~

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. ~~(TN Reading 3, 4; NCCER 27101-13; 27102-13)~~

Career Exploration

4) Referencing data from U.S. Department of Labor and other sources, explain an apprenticeship. Write persuasively to describe the benefits of the apprenticeship approach of on-the-job training paired with related training for individuals seeking construction careers. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. ~~(TN Reading 1, 7, 8; TN Writing 1, 8; NCCER 27101-13)~~

5) Research apprenticeships and postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer construction-related programs. Write an informative paper or develop an infographic identifying entry requirements for a specific apprenticeship or postsecondary program of study, and the secondary courses that will prepare students to be successful in the program. (TN Reading 1; TN Writing 4, 7; NCCER 27101-13)

Construction Industry Principles

6) Investigate and report on the process for determining the zoning regulations of a building site. Describe how zone designation and regulations such as setbacks, ground coverage, and maximum height impact the design, placement, and use of a building on a given site, citing findings from the investigation. Read and interpret zoning ordinances and other regulations impacting a given site (city, county, historic district, subdivision regulations, etc.). (TN Reading 2, 3, 4; TN Writing 2)

7) Explain inspection procedures used to enforce building codes during the construction of a residential or commercial building, outlining the roles and responsibilities of the building inspector and the contractor and the intervals at which inspections are performed. (TN Reading 2, 3, 4)

Types of Structural Systems

8) Compare and contrast types of structural framing systems, including wood light-frame, structural steel, and reinforced concrete, analyzing the factors influencing the selection of a structural system for given building functions. Using textbooks, online resources, or examples in the community, select three buildings with different framing types and explain why each type was used for the building's function. (TN Reading 1, 2, 4, 5; TN Writing 2, 9; NCCER 27102-13)

Materials and Methods of Light-Frame Wood Construction

9) Distinguish among the basic types of wood framing systems, such as platform frames, balloon frames, and post-and-beam frames. Create a chart to define and compare the pros and cons of each type, citing examples of when each is used. (TN Reading 1, 2, 4, 5, 7; TN Writing 2, 9; NCCER 27105-13)

10) Analyze the characteristics and uses of various types of wood products used in light frame construction.
    a. Categorize types of wood as hardwood or softwood.
    b. Identify differences in woods used in interior and exterior applications.
    c. Identify grades of lumber, common lumber defects, and differences in treated and untreated lumber.
    d. Explain the difference between actual and nominal lumber sizes.
    e. Distinguish among the properties and uses of engineered wood products such as plywood, hardboard, particleboard, oriented strand board, mineral fiberboard, glulam lumber, and wood I-beams.
    Drawing on resources such as textbooks and wood product retailers' catalogs, examine actual wood product samples and create a written description of each, identifying the type and grade

of the product, noticing and naming any defects, and explaining common uses of the product. (TN Reading 1, 2, 4, 5, 7; TN Writing 2, 9; NCCER 27102-13)

Tools & Equipment

11) Accurately identify hand and power tools used in carpentry, describing the safe use and maintenance of each. Hand tools include levels, squares, planes, clamps, and hand saws. Power tools include power saws, drill presses, routers, laminate trimmers, portable power planes, power metal shears, and pneumatic and cordless nailers and staplers. For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. (TN Reading 2, 3, 4; NCCER 27103-13)

Construction Drawings & Specifications

12) Inspect and interpret a full set of construction drawings and specifications for a construction project including civil, architectural, structural, mechanical, plumbing, electrical, and fire protection drawings and specifications. Read and interpret different drawing types including plan view drawings, elevation view drawings, section drawings, detail drawings, and schedules. Explain the relationship between different types of drawing and the importance of cross-referencing different types of drawings with one another and cross-referencing drawings with specifications. For example, explain how a floor plan, elevation, and detail drawing may all be used to inform the reader about the layout and material of a given building component, such as a cabinet layout or an exterior wall. (TN Reading 1, 2, 4, 5, 6, 7, 9; NCCER 27104-13)

Floor Framing Systems

13) Implement geometric principles to square a building layout. For example, in the process of staking the corners of a building, check the layout for squareness by using the 3-4-5 rule based on right triangles and the Pythagorean Theorem. (TN Reading 3; TN Math N-Q, G-SRT; NCCER 27104-13)

14) Identify the components which make up a floor frame, analyzing the purpose of and interrelationships among each component and explaining the sequence in which each is constructed. (TN Reading 2, 3, 4, 5; NCCER 27105-13)

15) Read and interpret construction drawings to determine floor system requirements, such as the proper girder and joist size for a given span and floor load, and estimate the amount of material needed to frame a floor assembly. (TN Reading 1, 4, 7; TN Math N-Q; NCCER 27105-13)

16) Describe the procedures necessary to fasten sills to the foundation and construct a floor assembly. Apply the appropriate tools, equipment, and procedures to build a floor assembly. Work in teams to install girders, lay out and install floor joists, install bridging and blocking, and apply subflooring. (TN Reading 3; NCCER 27105-13)

Wall and Ceiling Framing Systems

17) Explain the procedure to lay out a wood frame wall, defining and describing the components such as plates, studs, partitions, door and window openings, bracing, and other components. (TN Reading 3, 4; NCCER 27111-13)

18) Read and interpret drawings to determine wall and ceiling frame requirements for a given residential or commercial structure. For example, calculate the length of a stud and estimate the amount of material needed to frame a wall and ceiling assembly. (TN Reading 4; TN Math N-Q; NCCER 27111-13)

19) Work in teams to construct a wall frame and ceiling assembly by implementing required safety techniques, tools, and equipment. Accurately measure and lay out the frame; accurately level and plumb the walls. (TN Reading 3; TN Math N-Q; NCCER 27111-13)

Roof Framing Systems

20) Define and describe the framing components of gable and hip roofs such as the ridge board, plates, and types of rafters. Create a graphic illustration showing the roles of each component and how they work together in a roof framing system. (TN Reading 3, 4, 7; NCCER 27112-13)

21) Read and interpret drawings to determine roof framing requirements, such as calculating the length of a rafter based on the desired pitch and estimating the materials needed to frame and sheath a roof. For example, use a speed square to lay out a common rafter on a piece of lumber. (TN Reading 2, 3, 4; TN Math N-Q, G-SRT; NCCER 27112-13)

22) Work in teams to construct a roof frame assembly by implementing required safety techniques, tools, and equipment to accurately measure, lay out, construct, and sheath a roof frame. For example, frame a gable roof with an opening. (TN Reading 3; TN Math N-Q; NCCER 27112-13)

23) Compare and contrast different procedures to frame a roof. For example, describe the benefits of using prefabricated trusses in place of framing with rafters on site. Outline the major similarities and differences in each and write persuasively to describe why using either prefabricated trusses or framing with rafters is more beneficial for a specific project. (TN Reading 2, 3, 4; TN Writing 1, 4, 7, 9; NCCER 27112-13)

Introduction to Building Envelope Systems

24) Analyze the components of a building envelope system, including building wrap, insulation, and various types of windows and exterior doors. Describe how the selection and installation of various components affect the energy efficiency of the building, such as the impact of air sealing on energy efficiency. Identify materials and installation strategies used to minimize or prevent air infiltration. For example, explain how the glass type and the proper installation of a window impact the energy efficiency of the building. (TN Reading 2, 4, 5; TN Physical Science 2; TN Physics 2; NCCER 27109-13)

25) Describe the procedures necessary to prepare a rough opening and install windows and doors. Apply the appropriate tools, equipment, and procedures to prepare rough openings for proper window and door installation. Properly install a lockset in an exterior door. (TN Reading 3; TN Math N-Q; NCCER 27109-13)

Basic Stair Framing Systems

26) Analyze the components of a stair system. Read and interpret construction drawings to determine stair system requirements such as the total rise, number and size of risers, and number and size of treads. Based on stated requirements, estimate the amount of material needed to frame a stair assembly. (TN Reading 2, 3, 4, 5, 7; TN Math N-Q; NCCER 27110-13)

27) Apply the appropriate tools, equipment, and procedures to safely build a small stair unit, demonstrating proper procedures for laying out and cutting stringers, risers, and treads. (TN Reading 3; TN Math N-Q; NCCER 27110-13)

Business and Project Management

28) Describe strategies used to promote collaboration, trust, and clear communication among internal and external parties on a job site. Practice effective verbal, nonverbal, written, and electronic communication skills for working with colleagues, employers, clients, and other personnel while demonstrating the ability to: listen attentively, speak courteously and respectfully, resolve obstacles in construction, and respond to criticism. For example, assume the roles of a construction business owner and a potential client, listen to the needs of a potential client, and respond to the potential client by email; explain the services provided by the company and the next steps needed to begin the project. Other role playing could include a construction business owner and a potential subcontractor. (TN Reading 2, 3; TN Writing 2, 4)

29) Describe the components and purpose of a basic contract document for a residential project. Recognize the relationship and responsibilities of various parties to a contract. Write a basic contract for a construction job, such as a carpenter's contract to complete a deck addition for a residential client. (TN Reading 2, 3, 4, 5; NCCER 44105-08)

30) Interpret construction drawings to determine the correct materials, tools, and equipment needed to complete a construction project. Plan and implement the steps needed to complete the project, adhering to inspection procedures and employing safe practices throughout. Draw from print and electronic examples to create a materials list, cost estimation, construction schedule, and inspection checklist for a project, applying the components of the documents to the given project. (TN Reading 2, 3; TN Writing 4)

31) Log daily activities completed during a construction project over an extended period of time. Document important facts concisely in a daily report as would a project manager on a jobsite, including daily progress, equipment and materials used, personnel involved, and other work-related activities. (TN Reading 3; TN Writing 2, 5, 10)

Portfolio

32) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction.* Continually reflect on coursework experiences and revise and refine the career plan generated in the prior course, using technology where appropriate. Include photographs or illustrations and written descriptions of sequential progress in construction projects. ~~(TN Writing 2, 4, 5, 6)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN Physical Science: Tennessee Science: Physical Science standard 2 may provide additional insight and activities for educators.~~
- ~~TN Physics: Tennessee Science: Physics standard 2 may provide additional insight and activities for educators.~~
- NCCER Curriculum: [National Center for Construction Education and Research](#)
    - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for NCCER Carpentry Level One and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Structural Systems II

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6165
Prerequisite(s):	*Structural Systems I* (6164)
Credit:	1-2 credits (see Recommended Credit below)
Grade Level:	11-12
Graduation Requirements:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the third course in the *Structural Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER Carpentry.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	522, 575, 580, 592, 706
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Structural Systems II is an advanced-level course that builds on the introductory skills learned in the *Fundamentals of Construction* and *Structural Systems I* courses. This course will explore advanced framing, the physics of structural loads, and the coverings and finishes of structural systems. Upon completion of this course, proficient students will be able to install interior and exterior finishing, including roofing, siding, thermal and moisture protection components, drywall, doors, and trim.

Approved January 30, 2015; Amended April 15, 2016

Throughout the course, students will interpret construction drawings to complete projects, implementing material estimating procedures and safe working practices. Standards in this course also expand on principles of the construction industry and delve deeper into business and project management strategies. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Physical Science Standards, Tennessee Physics Standards, and the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is the third course in the *Structural Systems* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one or two credits, this course can feed into a fourth-level *Construction Practicum* course in which students can apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Recommended Credit

If all standards in this course are covered, the course is recommended for two credits. If only one credit is to be offered, it is recommended that the following standards be covered:

1 Credit Option

Content	Standards
Safety	1, 2, 3
Tools & Equipment	4
Construction Industry Principles	5, 6
Structural Systems Loads	7, 8
Cold-Formed Steel Framing	9, 10
Exterior Finishing	11, 12, 13, 14
Thermal & Moisture Protection	15, 16, 17, 18
Roofing Applications	19, 20
Green Building	33
Construction Drawings & Specifications	34, 35
Business & Project Management	36, 37, 38
Portfolio	39

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures. (TN Reading 3, 4, 6; TN Writing 2, 4)

2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. (TN Reading 3, 4)

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. (TN Reading 3, 4)

Tools & Equipment

4) For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the construction industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency and reduce muscle fatigue for a construction team. (TN Reading 1, 2, 3, 4; TN Writing 1, 4, 7, 9)

Construction Industry Principles

5) Locate and assess the Tennessee Contractor's Licensing Board's website and analyze the policies and requirements for construction work in Tennessee. Explain how such policies impact local construction businesses. (TN Reading 2, 3, 4)

6) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client describing the services provided and explaining the project delivery method used by the company. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4, 8; NCCER 44105-08)

Structural System Loads

7) Categorize and describe the structural loads that act on a building, including vertical loads (such as dead loads, live loads, and rain loads) and lateral loads (such as wind and earthquakes). Drawing on textbooks and other resources, create a visual display with supporting text to explain how the various loads act on a building's structural system. (TN Reading 2, 4, 5, 7; TN Writing 2; TN Physics 1)

8) Distinguish among the types of structural failures that can occur in a structural system, including compressive failures, tensile failures, and buckling failures. Explain how specific components of a structural system prevent structural failures based on descriptions in texts and through classroom experiments, synthesizing information gathered from both to illustrate concepts. For example, explain how blocking between studs in a wood frame wall prevents the buckling of studs. (TN Reading 2, 4, 5, 7, 8, 9; TN Writing 2)

Cold-Formed Steel Framing

9) Examine the components, fasteners, tools, and procedures used in cold-formed steel framing; compare and contrast cold-formed steel framing with wood framing in building construction. Outline the major similarities and differences in each and write persuasively to provide a recommendation to a client for a specific project. (TN Reading 2, 3, 4; TN Writing 1, 4, 9; NCCER 27205-13)

10) Demonstrate the ability to build steel frame components including back-to-back, box, and L-headers. Work in teams to lay out and install steel stud walls (both structural and non-structural) with openings to include bracing and blocking by implementing required safety techniques, tools, and equipment. (TN Reading 3; TN Math N-Q; NCCER 27205-13)

Exterior Finishing

11) Examine a wall section drawing for a specific building. Identify, define, and explain the function of each component including wall insulation, flashing, and the structure of the cornice. Draw from textbooks and other resources to annotate the wall section drawing with notes explaining the purpose of each component. (TN Reading 1, 2, 3, 4, 5, 7; Writing 2, 4, 9; NCCER 27204-13)

12) Interpret wall section drawings to safely construct a cornice. For example, accurately measure materials, employ tools, and follow procedures to build a box cornice, checking for accuracy in each step. (TN Reading 3; TN Math N-Q; NCCER 27204-13)

13) Analyze various finish systems used to sheath a building, including but not limited to wood siding, fiber-cement siding, vinyl siding, metal siding, stucco, and masonry veneer finishes. Perform a case study of three different buildings in the community which are sheathed in different ways, hypothesizing why the different materials and methods were selected for each. (TN Reading 2, 3, 4; NCCER 27204-13)

14) Estimate the siding materials needed to cover a building utilizing mathematical principles such as area formulas and quantitative reasoning. Utilize the appropriate procedures, tools, and materials to install various types of siding. For example, identify three siding methods that are commonly used in the area and demonstrate the ability to plan the installation of and install each. (TN Reading 3; Math N-Q; NCCER 27204-13)

Thermal & Moisture Protection

15) Explain the impact of heat transfer in a building, including heat loss during cold temperatures and heat gain during warm temperatures. Describe how building components such as insulation work to resist the transfer of heat in a structure. Interpret charts and graphs in building codes to determine the recommended r-values of insulation in a given location. (TN Reading 2, 4, 5; TN Physical Science 2; TN Physics 2; NCCER 27203-13)

16) Categorize the various types of insulation based on their characteristics and installation method. Summarize the key properties and installation procedures of each insulation type in a visual display. (TN Reading 2, 3, 4, 7; NCCER 27203-13)

17) Describe the materials and methods used in a structure for moisture control, waterproofing, and ventilation. In a written narrative, explain how a vapor barrier protects an interior from moisture and describe the permeability rating necessary for a material to be considered a vapor retarder. Write guidelines for a builder or architect to use as reference when selecting appropriate vapor barriers for a specific location based on the climate and other factors, citing evidence from textbooks and other resources. (TN Reading 1, 2, 4; TN Writing 2, 4, 7, 9; NCCER 27203-13)

18) Interpret construction drawings and building codes to select and estimate the thermal and moisture protection materials needed to complete a project utilizing mathematical principles such as area formulas and quantitative reasoning. Utilize the appropriate procedures, tools, and materials to install blanket insulation in a wall, a vapor barrier on a wall, and building wraps. (TN Reading 2, 3, 4; TN Math N-Q; NCCER 27203-13)

Roofing Applications

19) Compare and contrast the materials, methods, and procedures for roofing with fiberglass shingles with other roofing materials such as wood shingles, metal roofing, and membrane-type roofing systems. Perform a cost analysis for a client to help the client choose between two roofing materials for a specific project given the site location, project budget, environmental considerations, and other factors. (TN Reading 2, 3, 4; TN Math N-Q; NCCER 27202-13)

20) Apply the appropriate tools, equipment, and procedures to safely install shingles on a roof including strategies for watertight installation, using quantitative reasoning and geometric

formulas where applicable. For example, interpret construction documents to estimate the roofing materials needed to install fiberglass shingles on a gable roof. After preparing the roof with underlayment, flashing, and other preparation materials, install fiberglass shingles, install a cricket or saddle, and install ridge caps. (TN Reading 3; TN Math N-Q, G-SRT; NCCER 27202-13)

Windows, Doors, and Door Hardware

21) Describe the common styles and components of windows. Read and interpret construction drawings, window schedules, specifications, and manufacturers' information to determine the types of window and installation procedures required for a project. Apply the appropriate tools, equipment, and procedures to safely install windows. (TN Reading 2, 3, 4)

22) Analyze the parts of a door frame, including sills, jambs, and casings, and describe different interior door types. Read and interpret door schedules and other construction documents to determine the type of door and door hardware required for a project. (TN Reading 2, 4; NCCER 27208-13, 27201-13)

23) Apply the appropriate tools, equipment, and procedures to safely install a door, including checking the plumb and square of a door frame and installing a prehung door unit. Demonstrate proper procedures to work with door hardware, including laying out and cutting hinges in a wooden door and installing door closers and locksets. (TN Reading 3; TN Math N-Q; NCCER 27208-13)

Drywall Installation & Finishing

24) Describe the various components involved in drywall installation, including the types of drywall, drywall fasteners and adhesives, and drywall accessories. Explain the procedure to install drywall, noting the proper tools involved. Describe the role drywall plays in sound isolation and fireproofing, outlining how fire-rated walls are constructed. (TN Reading 3, 4, 5; NCCER 27206-13)

25) Read and interpret drawings to select the type and thickness of drywall required for a specific installation. Utilize quantitative reasoning to estimate the amount of drywall, fasteners, and finishing materials needed for a project. (TN Reading 2, 4, 6; TN Math N-Q; NCCER 27206-13)

26) Install gypsum drywall panels on stud walls and ceilings using different types of fastening systems, including nails, screws, and adhesives. Perform single-layer and multi-layer installations by implementing required safety techniques, tools, and equipment. Describe the differences in procedures for installing gypsum panels on steel wall frames. (TN Reading 2, 3; TN Math N-Q; NCCER 27206-13)

Drywall Finishing

27) Describe the procedures, tools, and materials used in drywall finishing, indicating the purpose of each material. Read and interpret industry standards regarding drywall finish such as the *Recommended Levels of Gypsum Board Finish.* Observe finished drywall and determine the level

of finish, citing evidence from industry standards documents. (TN Reading 1, 2, 3, 4, 6, 7; TN Writing 9; NCCER 27207-13)

28) Implement the proper procedures, tools, and materials to finish drywall. Procedures include preparing compounds, taping joints, applying joint compounds, sanding, spotting fastener heads, and finishing corners. (TN Reading 3; NCCER 27207-13)

29) Diagnose the cause and determine the appropriate solution for problems that occur in drywall finishing, citing evidence from textbooks or technical manuals in order to justify why the chosen solution is appropriate. Implement the proper tools and procedures to patch damaged drywall. (TN Reading 1, 2, 3, 4; TN Writing 9; NCCER 27207-13)

Window, Door, Floor, and Ceiling Trim

30) Distinguish among the different types of standard trim, including base, wall, ceiling, window, and door trim. Utilize the proper tools, equipment, and procedures to make square cuts, miter cuts, and coped joint cuts in trim. (TN Reading 2, 3, 4; NCCER 27210-13)

31) Apply the appropriate tools, fasteners, and procedures to install window, door, floor, and ceiling trim. Estimate the quantities of different trim materials needed for a given room. (TN Reading 3; TN Math N-Q; NCCER 27210-13)

Cabinet Installation

32) Identify the components which make up a basic set of cabinets, analyzing the purpose of and interrelationships among each component and explaining the sequence in which each is constructed. Components include wall cabinets, base cabinets, countertops, and cabinet hardware. Read and interpret drawings and technical manuals to determine the steps, equipment, and materials needed to lay out and install a basic set of cabinets. Develop a timeline and action steps needed to complete a cabinet installation. For example, narrate the steps in an explanatory text that a peer could use to install a set of cabinets. (TN Reading 1, 2, 3, 4, 5, 7; TN Writing 2, 4; NCCER 27211-13)

Green Building

33) Research and identify green strategies used in the design and construction of buildings specifically impacting carpenters. Drawing on resources such as those from the U.S. Green Building Council, discuss green work practices of carpenters, such as reducing waste in the construction process, citing resources to support claims. (TN Reading 1, 2, 4; NCCER 70101-09)

Construction Drawings & Specifications

34) Explain the relationship between construction drawings and specifications. For example, describe how both the construction drawings and specifications provide information about the exterior sheathing indicated for a building. Examine construction drawings and specifications, to determine the requirements of the sheathing for a given part of a building, and verify with measurements and other sources as needed. (TN Reading 1, 2, 4, 5, 6, 7, 8; NCCER 27201-13)

35) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI), as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product. (TN Writing 4; NCCER 44105-08)

Business & Project Management

36) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals. (TN Reading 2, 6; TN Writing 2)

37) Perform estimating and scheduling techniques for a long-term project, including calculating material quantities and cost (including tax) and labor cost to complete a bid sheet; scheduling construction activities using a flow chart; and determining amounts to be charged to the client at various intervals throughout the project. (TN Reading 3, 7; TN Math N-Q)

38) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during construction activities as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule. (TN Reading 3; TN Writing 2, 4, 6, 10)

Portfolio

39) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Structural Systems I*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses, using technology where appropriate. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

- NCCER Curriculum: National Center for Construction Education and Research
  - o   Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for NCCER Carpentry Level Two and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o   Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Mechanical, Electrical, & Plumbing Systems

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6161
Prerequisite(s):	*Fundamentals of Construction* (6073)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the second course in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	501, 502, 523, 527, 532, 567, 580, 592, 598, 701, 703, 707
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Mechanical, Electrical, & Plumbing Systems prepares students for electrical, plumbing, and HVAC careers by introducing students to the physical principles of these systems and the fundamental skills needed to work with them. Upon completion of this course, proficient students will be able to follow safety procedures and use tools to perform basic operations with electrical circuits, as well as demonstrate understanding in fundamental concepts of electricity theory (i.e. Ohm's Law). Students will be able to apply proper tools and procedures to perform basic operations with plastic piping, including measuring,

cutting, and joining pipe. Furthermore, students will be able to apply mathematics concepts to solve HVAC, electrical, and plumbing problems. Standards in this course also include principles of the construction industry and business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Physical Science Standards, Tennessee Physics Standards, and the National Center for Construction Education and Research (NCCER) Curriculum.*

Program of Study Application

This is the second course in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Perform a hazard assessment for a given task, such as working on a ladder to install electrical components. Explain the steps necessary to safely perform the task, outlining steps to take in case of an emergency. (TN Reading 3, 4, 6; TN Writing 2; NCCER 02102-12)

2) Continue to maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. (TN Reading 3, 4; NCCER 02102-12)

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. (TN Reading 3, 4; NCCER 02102-12)

Tools & Equipment

4) For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. For example, demonstrate the

ability to safely use a deburring tool to ream a pipe end and effectively clean and store the tool. ~~(TN Reading 3; NCCER 02103-12)~~

Career Exploration

5) Compare and contrast career opportunities within the HVAC, electrical, and plumbing industries. Building on career exploration conducted in *Fundamentals of Construction*, produce a chart or other graphic comparing the skills, responsibilities, and personal characteristics of successful professionals in each of the three industries. Drawing on the research, create a personnel profile or a mock job description for one of these professionals, citing the use of skills and characteristics during a typical day on the job. ~~(TN Reading 2, 4, 5, 7, 9; TN Writing 2; NCCER 02101-12, 26101-14, 03101-13)~~

6) Explain what an apprenticeship is, referencing data from the U.S. Department of Labor and other sources. Write persuasively to describe the benefits of the apprenticeship approach of on-the-job training paired with related training for individuals seeking construction careers. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. ~~(TN Reading 1, 7, 8; TN Writing 1, 8; NCCER 26101-14, 03101-13)~~

7) Research apprenticeships and postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer construction-related programs. Write an informative paper or develop an infographic identifying entry requirements for a specific apprenticeship or postsecondary program of study, and the secondary courses that will prepare students to be successful in the program. ~~(TN Reading 1, 3; TN Writing 2, 4, 7)~~

Construction Industry Principles

8) Examine how the roles and responsibilities among construction trades and professions work in relationship to completing a project. Describe how electricians, plumbers, and HVAC technicians coordinate work with other construction personnel to complete a project, including submitting bids for subcontracted work and requesting clarification through a RFI (request for information) process. ~~(TN Reading 2, 3, 4; TN Writing 2)~~

9) Explain inspection procedures used to enforce building codes during the construction of a residential or commercial building, outlining the roles and responsibilities of the building inspector and the contractor and the intervals at which inspections are performed. ~~(TN Reading 2, 3, 4)~~

Construction Math

10) Apply mathematics concepts to solve HVAC, electrical, and plumbing problems, distinguishing which principles apply to a given problem. Concepts should include, but are not limited to: Concepts from *Fundamentals of Construction*:
    a. Operating with whole numbers, fractions, and decimals. ~~(TN Math N-Q; NCCER 02104-12, 03102-13)~~

     b.   Performing conversions between fractions, decimals, and percentages. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch. (TN Math N-Q; NCCER 02104-12)

     c.   Working with units such as feet, inches, meters, centimeters, and millimeters, and determining appropriate units for a given construction task. For example, determine how many pieces of 2 ft. 4 in. PVC pipe may be cut from a 10 ft. piece and how much pipe will be left over. (TN Math N-Q; NCCER 02104-12, 03102-13)

     d.   Calculating the area of two-dimensional spaces. Calculating surface area and volume for three-dimensional objects employing related geometric terminology. (TN Math G-GMD, G-MG; NCCER 02104-12, 03102-13)

     e.   Performing proportionate reasoning to estimate quantities. (TN Math N-Q)

     f.   Using basic rules of right triangles, such as the Pythagorean Theorem, to find missing lengths. (TN Math G-SRT)

Additional Concepts:

     g.   Performing conversions between the metric system and the English system and among units within the metric system. (TN Math N-Q; NCCER 02104-12, 03102-13)

     h.   Calculating the square and square root of numbers. (TN Math A-SSE; NCCER 02104-12)

     i.   Solving algebraic equations. (TN Math A-REI; NCCER 03102-13)

     j.   Calculating values associated with angles and triangles. (TN Math G-SRT; NCCER 03102-13)

Electrical Systems

11) Describe how different levels of electrical shock affect the human body. Research current OSHA standards and other regulations specific to job-site electrical safety to identify methods and equipment to reduce the risk of injury due to electrical shock. Drawing on evidence from textbooks and OSHA standards, apply lockout/tagout procedures to ensure safe conditions for working on electrical systems. For example, perform a lockout/tagout on a circuit breaker. (TN Reading 1, 2, 3, 4; NCCER 26102-14)

12) Examine basic electrical circuits and components. Explain the difference between conductors and insulators. Demonstrate understanding of the layout and operation of electrical circuits (series, parallel, and series-parallel circuits). Define voltage, resistance, current, and the units of measure associated with each. Describe the relationship between voltage, resistance, and current as defined by Ohm's law. Compare and contrast the instruments used to measure voltage, resistance, and current. (TN Reading 3, 4, 5; TN Math N-Q; TN Physical Science 2; NCCER 26103-14)

13) Apply Ohm's law and Kirchhoff's laws to solving given problems in electrical circuits. Defend the solution using supporting evidence that explains the cause and effect relationship between the laws and each of the following:

     a.   Voltage
     b.   Current
     c.   Resistance
     d.   Voltage drop

For example, use Ohm's law to calculate the current flow of a circuit for an electric dryer with a given voltage and resistance. (TN Reading 1, 2, 3, 4, 5; TN Writing 1, 4; TN Math N-Q, A-SSE, A-CED, A-REI; TN Physical Science 2; NCCER 26104-14)

14) Building on knowledge of basic electrical circuits, examine a residential wiring system and explain the layout and the basic function of each component in the system (i.e. service entrance, electric meter, service entrance panel, subpanel, circuit breakers, switches, receptacles, and conductors). Distinguish between branch circuits and feeder circuits. Describe the difference between resistive and inductive loads in electrical circuits and explain how physical laws apply. Study a residential wiring plan and identify common electrical symbols used. In a written or oral presentation, explain a simple residential electrical wiring plan to a peer, accurately describing the name and function of each component, how the components work together, and the impact of the physical laws on the circuit. (TN Reading 2, 4, 7; TN Physical Science 2; NCCER 26103-14)

15) Analyze the composition and properties of conductors. Explain how the markings on a conductor relate to the physical properties of the conductor, including the insulation and jacket material, conductor size and type, number of conductors, temperature rating, voltage rating, and permitted uses of the conductor. Inspect electrical charts and tables to determine the ampacity of a given conductor and to draw conclusions about the relationships among the physical properties of a conductor, such as size and ampacity. Explain how color coding is used to distinguish among conductor purposes. Create a visual display a beginning electrician might use to interpret the meaning of color and markings on conductors. (TN Reading 1, 2, 3, 4; TN Writing 4; NCCER 26109-14)

16) Determine the procedures necessary to safely replace or install electrical devices in a device box, such as a light fixture, receptacle, or switch. Draw on resources such as the device manufacturer's instructions and other instructional texts to determine the tools, steps, and safety procedures involved. Apply knowledge about conductors and electrical lockout/tagout procedures to safely complete installations of a device in a device box. Steps should include using test equipment to verify the power is off and connecting conductors to the proper terminals. For example, install a single-pole switch in a device box. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4)

Plumbing Systems

17) Examine safety considerations specific to plumbers by identifying possible hazards on a job site. In a written or oral presentation, explain how to work safely in and around confined spaces and trenches, as a journeyman plumber would to a plumber's helper. (TN Writing 4; NCCER 02102-12)

18) Describe the movement of potable water and waste within the plumbing systems of a building, drawing distinctions between water supply systems and drain, waste, and vent systems. Explain how physical principles such as gravity and pressure apply within plumbing systems, and how they contribute to the proper functioning and efficiency of the system. Illustrate why an understanding of these physical principles is important to a plumbing professional in the design, installation, maintenance, and repair of plumbing systems. (TN Reading 2, 3, 4, 5, 7; TN Writing 2; TN Physical Science 1, 4; NCCER 02111-12)

19) Determine common requirements found in plumbing codes and explain why the codes are necessary; include the importance of proper plumbing on human health. Examine a health or safety issue involved with plumbing. Write an explanatory text to illustrate the problem and

describe how it can be prevented or remedied with proper plumbing applications. (TN Reading 2, 4, 5; TN Writing 2; NCCER 02111-12)

Piping

20) Analyze the parts of a pipe fitting including the face, center, and back. Determine fitting allowances by using measuring and calculating techniques and by consulting manufacturer's tables. Calculate the length of pipe needed for a given application by implementing common pipe measuring techniques. (TN Reading 3, 4; TN Math N-Q; NCCER 02104-12)

21) Compare and contrast the material properties and uses of the various types of plastic piping, including storing and handling, safety issues, and types of fitting and hanging equipment. Analyze the use of plastic piping in plumbing systems and HVAC systems. Describe the factors influencing the decision to use plastic piping in a residence. Demonstrate the ability to select the correct materials, tools, and PPE to complete plastic piping projects by creating a list of the items needed for a specific installation. For example, for a residential bathroom sink drain, create a basic list of the materials, tools, and equipment needed to install the drain. (TN Reading 2, 3, 4, 7; TN Writing 4, 9; NCCER 02106-12)

22) Employ tools and procedures to safely measure, cut, ream, and join plastic piping and fittings. For example, accurately measure PVC pipe, use a miter box and handsaw to cut pieces of pipe, ream and chamfer the ends, and join the pipe using solvent cement. (TN Reading 3, 4; TN Math N-Q; NCCER 02106-12)

Heating, Ventilation, and Air Conditioning Systems (HVAC)

23) Examine safety considerations specific to HVAC technicians by identifying possible hazards on a job site. Analyze the regulations that impact the work of HVAC technicians, such as the Clean Air Act and EPA guidelines. Create an informational artifact summarizing these regulations to an individual contemplating starting an HVAC business, explaining key considerations and citing resources that the future business owner can consult. (TN Reading 1, 2, 4; TN Writing 2, 4, 9; NCCER 03101-13)

24) Describe the basic components included in an HVAC system, outlining the purposes of each, citing textual resources such as blueprints, manuals, and manufacturers' specifications. Drawing on this evidence, write persuasively to describe the impact of a well-tuned HVAC system on building energy efficiency as well as on human health and well-being. Similarly, describe the negative consequences that can arise due to a poorly functioning or improperly installed HVAC system. (TN Reading 1, 2, 4, 6, 7; TN Writing 1, 8, 9; NCCER 03101-13)

25) Explain the fundamental concepts of heating and combustion, including describing the processes by which heat is transferred. Illustrate the differences in heat transfer by conduction, convection, and radiation by performing experiments. Record observations, citing evidence that heat is being transferred, identifying the heat source, noting the direction heat is moving, and determining the type of heat transfer taking place. (TN Reading 2, 3, 4, 5; TN Writing 7; TN Physical Science 2; TN Physics 2; NCCER 03108-13)

26) Relate the types of heat transfer to the various heating systems used within a building. Examine the basic layout of a heating system within a building, such as a single family residence, and note the movement of heat, identifying areas of heat loss and heat gain. Citing the principles of heat transfer, propose strategies the homeowner could use to conserve energy in the home. (TN Reading 2, 3, 4, 5; TN Physical Science 2; TN Physics 2; NCCER 03108-13)

Construction Drawings & Specifications

27) Inspect and interpret a full set of construction drawings and specifications for a construction project including civil, architectural, structural, mechanical, plumbing, electrical, and fire protection drawings and specifications. Read and interpret different drawing types including plan view drawings, elevation view drawings, section drawings, detail drawings, and schedules. Explain the relationship between different types of drawing and the importance of cross-referencing different types of drawings with one another and cross-referencing drawings with specifications. For example, explain how a floor plan, elevation, and detail drawing may all be used to inform the reader about the location of a given building component, such as a lighting fixture. (TN Reading 1, 2, 4, 5, 6, 7, 9; NCCER 44105-08)

Business and Project Management

28) Describe strategies used to promote collaboration, trust, and clear communication among internal and external parties on a job site. Practice effective verbal, nonverbal, written, and electronic communication skills for working with colleagues, employers, clients, and other personnel while demonstrating the ability to: listen attentively, speak courteously and respectfully, resolve obstacles in construction, and respond to criticism. For example, assume the roles of a construction business owner and a potential client, listen to the needs of a potential client, and respond to the potential client by email; explain the services provided by the company and the next steps needed to begin the project. Other role playing could include a construction business owner and a potential subcontractor. (TN Reading 2, 3; TN Writing 2, 4; NCCER 00108-09)

29) Log daily activities completed during a project. Document important facts concisely in a personal daily report as would a technician to a supervisor including daily progress, equipment and materials used, personnel involved, and other occurrences. (TN Reading 3; TN Writing 2, 5, 10)

Portfolio

30) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction*. Continually reflect on coursework experiences and revise and refine the career plan generated in the prior course. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Geometry.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN Physical Science: Tennessee Science: Physical Science standards 1, 2, and 4 may provide additional insight and activities for educators.~~
- ~~TN Physics: Tennessee Science: Physics standard 5 may provide additional insight and activities for educators.~~
- NCCER Curriculum: [National Center for Construction Education and Research](#)
  - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive module credit for NCCER and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Plumbing Systems

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6082
Prerequisite(s):	*Mechanical, Electrical, & Plumbing Systems* (6161)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is one of the third-level course options in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER Plumbing Level One.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	527, 567, 580, 592, 703
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Plumbing Systems prepares students for careers in plumbing across a variety of residential and commercial settings. Upon completion of this course, proficient students will be able to implement safety procedures and tools to perform operations with plumbing systems. Students will be able to explain how drain, waste, and vent (DWV) systems, water distribution systems, and plumbing fixtures work and apply proper tools and procedures to perform operations with plumbing piping, including measuring, cutting, joining, supporting, and hanging various types of pipe. Students will read and

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interpret drawings, specifications, and diagrams to determine materials needed to complete a plumbing project. Standards in this course also introduce basic maintenance and troubleshooting procedures and expand on principles of the construction industry, delving deeper into business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee State Standards in Chemistry I, Physics, Physical Science, and Environmental Science, as well as the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is one of the third-level course options available in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study. This course can feed into a fourth-level *Construction Practicum* course in which students apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing these programs in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures. ~~(TN Reading 3, 4, 6; TN Writing 2, 4; NCCER 02102-12)~~

2) Continue to maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4; NCCER 02102-12)~~

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by

planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. Describe hazards involved with plumbing work, including working in confined spaces. (TN Reading 3, 4; NCCER 02102-12)

Tools & Equipment

4) Identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the plumbing industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency for a plumber. (TN Reading 2, 3, 4; TN Writing 1, 7; NCCER 02103-12)

Construction Industry Principles

5) Locate and assess requirements for performing plumbing work including local, state, and national requirements. Interpret plumbing codes, and determine inspection procedures and other applicable portions of the law. Visit the Tennessee Contractor's Licensing Board's website and analyze its policies and requirements. Explain how such policies impact local construction businesses. (TN Reading 2, 3, 4, 9)

6) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client, describing the services provided and explaining the project delivery method used by the company. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4; NCCER 44105-08)

Construction Drawings & Specifications

7) Building on knowledge of construction drawings and specifications from *Mechanical, Electrical, & Plumbing Systems*, examine plumbing drawings and identify common plumbing symbols used for the components of pipe assemblies. Read and interpret construction drawings, including detail drawings and equipment schedules, to create a list of materials needed for a given plumbing project. For example, analyze plumbing plans and isometric drawings to determine the materials needed to install a drain, waste, and vent system. (TN Reading 2, 3, 4, 6, 7; TN Writing 2, 9; NCCER 02105-12)

8) Explain the relationship between construction drawings and specifications. Describe how both the construction drawings and specifications provide information about the plumbing system for a building. For example, examine construction drawings and specifications to determine the requirements of hangers and supports for a given plumbing piping system. (TN Reading 1, 2, 4, 5, 6, 7; NCCER 02105-12, 44105-08)

9) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI) as would a construction professional to an architect to request

clarification for a detail of the construction documents, such as the selection of a product. (TN Reading 6; TN Writing 4; NCCER 02105-12, 44105-08)

10) Demonstrate the ability to use an architect's scale to measure a component of a scale drawing. Create drawings commonly used in the plumbing trade, including orthographic and isometric sketches. (TN Math G-MD, G-MG; NCCER 02105-12)

Plumbing Math

11) Apply mathematics concepts to solve plumbing problems, distinguishing which principles apply to a given problem. Concepts should include, but are not limited to:
   a. Using the basic rules of right triangles, such as the 3-4-5 ratio, to lay out and check square corners. (TN Math G-SRT; NCCER 02104-12)
   b. Calculating values associated with angles and triangles to determine the run, travel, and rise of an offset. (TN Math G-SRT; NCCER 02104-12)

Plastic Pipe & Fittings

12) Building on the knowledge of plastic piping from *Mechanical, Electrical, and Plumbing Systems*, distinguish among different types of plastic plumbing pipe, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of plastic pipe and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining various types of plastic plumbing pipe, including ABS, PVC, CPVC, PE, PEX, and PB. Create a list of the appropriate piping materials, tools, and equipment needed for a given plastic piping application including supports and spacing. (TN Reading 1, 2, 4; TN Writing 4; NCCER 02106-12)

13) Read and interpret manufacturer's instructions, construction drawings and specifications, and applicable codes to properly install plastic pipe, including measuring, cutting, joining, and supporting plastic pipe. Utilize the appropriate tools, equipment, PPE, and procedures to safely complete installations. Once installed, pressure test plastic pipe according to local plumbing code to verify installation was properly completed. (TN Reading 2, 3; NCCER 02106-12)

Copper Tube & Fittings

14) Distinguish among different types of copper tube, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of copper tube and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining various types of copper tube. Create a list of the appropriate piping materials, tools, and equipment needed for a given copper tubing application including supports and spacing. (TN Reading 1, 2, 4; TN Writing 4; NCCER 02107-12)

15) Read and interpret manufacturer's instructions, construction drawings and specifications, and applicable codes to properly install copper tubing, including measuring, cutting, bending, joining, grooving, and supporting plastic pipe. Utilize the appropriate tools, equipment, PPE, and procedures to safely complete installations. Once installed, pressure test copper tube according

to local plumbing code to verify installation was properly completed. (TN Reading 2, 3, 6, 8; NCCER 02107-12)

Cast-Iron Pipe & Fittings

16) Distinguish among different types of cast-iron pipe, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of cast-iron pipe and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining hub-and-spigot cast-iron pipe and no-hub cast-iron pipe. Create a list of the appropriate piping materials, tools, equipment, and PPE needed for a given cast-iron piping application including selecting the correct supports and spacing. (TN Reading 1, 2, 4; TN Writing 4; NCCER 02108-12)

17) Demonstrate proper procedures to correctly measure, cut, and join cast-iron pipe utilizing the appropriate tools, equipment, and PPE. Describe testing procedures used to check cast-iron piping for leaking joints, as designated in local plumbing code. (TN Reading 2, 3; NCCER 02108-12)

Carbon Steel Pipe & Fittings

18) Distinguish among different types of steel pipe, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of steel pipe and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining steel pipe. Create a list of the appropriate piping materials, tools, and equipment needed for a given steel piping application including supports and spacing. (TN Reading 1, 2, 4; TN Writing 4; NCCER 02109-12)

19) Read and interpret manufacturer's instructions, construction drawings and specifications, and applicable codes to properly install steel pipe, including measuring, cutting, joining, and supporting steel pipe. Utilize the appropriate tools, equipment, PPE, and procedures to safely complete installations. (TN Reading 2, 3; NCCER 02109-12)

Plumbing Fixtures

20) Describe the features and operating principles of various types of plumbing fixtures, including sinks, lavatories, faucets, bathtubs, showers, and water closets. Analyze the operational procedures of two different water closets, such as a siphon-action water closet and a blow-out water closet. Compare and contrast the functions and benefits of each, citing resources to make a recommendation for a client based on the specific needs of a project. (TN Reading 1, 2, 3, 4, 7; TN Writing 2, 4, 9; TN Physical Science 2; NCCER 02110-12)

Drain, Waste, & Vent (DWV) Systems

21) Study a schematic plan of a typical community sewer system. Citing evidence from a technical description or actual observation of a system, explain how waste moves through a drain, waste, and vent system from the fixture to the environment. Create a graphic illustration to represent the movement of waste from one component to the others in the system. For example, create a

basic diagram of how the waste generated by a clean-up sink in the classroom travels to the local sewage treatment plant. (TN Reading 2, 3, 4, 7; NCCER 02111-12)

22) Demonstrate understanding of the specific roles of various plumbing components in a drain, waste, and vent system by sketching a system model. Label the components, and include a written description of the function of each. Be able to describe the physical principles involved such as gravity and pressure. (TN Reading 2, 3, 4, 5, 7; TN Writing 2; TN Physical Science 1, 4; NCCER 02111-12)

23) Analyze the function of a trap by examining a drain, waste, and vent system whose trap has lost its seal. Diagnose and explain the cause and determine the appropriate solution, citing evidence from textbooks or technical manuals in order to justify why the chosen solution is preferable or more effective than another. (TN Reading 1, 2, 4, 5; TN Writing 2, 9; NCCER 02111-12)

Water Distribution Systems

24) Study a schematic plan of a typical municipal water distribution system. Citing evidence from a technical description or actual observation of a system, explain how water travels from a water treatment plant to a fixture in a residence. Create a graphic illustration to represent the movement of water from one component to the others in the system. For example, sketch an isometric drawing of a simple water distribution system and label its components. (TN Reading 1, 2, 3, 4, 7; TN Writing 2, 9; NCCER 02112-12)

Basic Maintenance & Repair Process

25) Identify and demonstrate basic troubleshooting strategies appropriate for evaluating plumbing systems and devices. For example, in a drain system, develop and implement a troubleshooting strategy to test and remedy a clogged drain. (TN Reading 3)

26) Identify routine maintenance procedures that should be performed on plumbing systems for a given building. Create a timeline of recommended maintenance procedures for a client, justifying why each procedure is necessary by highlighting its preventive or cost-efficient characteristics. For example, create a schedule of items to inspect and clean in order to keep a water heater running efficiently. (TN Reading 2, 3, 4, 7; TN Writing 4)

Green Practices in Plumbing

27) Define the term *efficiency* in the context of the plumbing profession and plumbing systems. Research and identify strategies used in the design of plumbing systems and plumbing work practices to increase the efficiency of plumbing systems. Drawing on resources such as those from the U.S. Green Building Council and EPA Energy Star, create a recommendation for a client outlining green plumbing strategies for a given building. (TN Reading 2, 3, 4, 7, 9; TN Writing 2, 7, 8; TN Environmental Science 5)

Business & Project Management

28) Describe the components and purpose of a basic contract document for a residential project, determining the meaning of key terms and other industry-specific words. Recognize the relationship and responsibilities of various parties to a contract. Write a basic contract for a job, such as a plumbing service agreement for work done for a residential client. ~~(TN Reading 2, 3, 4, 5; NCCER 44105-08)~~

29) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals. ~~(TN Reading 2, 6; TN Writing 2)~~

30) Interpret construction drawings and applicable local plumbing codes to determine the correct materials, tools, and equipment needed to complete a plumbing project. Plan and implement the steps needed to complete the project, adhering to inspection procedures and employing safe practices throughout. Draw from print and electronic examples to create a material list, cost estimation, project schedule, and inspection checklist for a project, applying the components of the documents to the given project. ~~(TN Reading 2, 3; TN Writing 4)~~

31) Produce clear and coherent writing for communication in the plumbing industry. Create a service order for a given plumbing project. Explain the service order to a peer, as would a service technician to a client. ~~(TN Writing 4)~~

32) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during plumbing projects as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule. ~~(TN Reading 3; TN Writing 2, 4, 6, 10)~~

Portfolio

33) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Mechanical, Electrical, & Plumbing Systems*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses. Include photographs or illustrations and written descriptions of sequential progress in construction projects. ~~(TN Writing 2, 4, 5, 6)~~

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN Chemistry I: Tennessee Science: Chemistry I standard 2 may provide additional insight and activities for educators.~~
- ~~TN Physics: Tennessee Science: Physics standard 2 may provide additional insight and activities for educators.~~
- ~~TN Physical Science: Tennessee Science: Physical Science standards 1 and 2 may provide additional insight and activities for educators.~~
- ~~TN Environmental Science: Tennessee Science: Environmental Science standard 5 may provide additional insight and activities for educators.~~
- NCCER Curriculum: National Center for Construction Education and Research
  - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for NCCER Plumbing Level One and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Electrical Systems

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6075
Prerequisite(s):	*Mechanical, Electrical, & Plumbing Systems* (6161)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is one of the third-level course options in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students completing the course through an NCCER accredited program may receive module credit for NCCER.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	523, 532, 567, 580, 592, 701
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Electrical Systems prepares students for careers as electricians across a variety of residential and commercial environments. Upon completion of this course, proficient students will be able to implement safety procedures and tools to perform operations with device boxes, conduit, raceway systems conductors, and cable. Students will read and interpret the National Electrical Code, drawings, specifications, and diagrams to determine materials and procedures needed to complete a project. Students will calculate residential loads to recommend electrical hardware. Standards in this course also

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introduce basic troubleshooting procedures and power systems, and expand on principles of the construction industry, delving deeper into business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee State Standards in Chemistry I, Physics, Physical Science, and Environmental Science, as well as the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is one of the third-level options in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study. This course can feed into a fourth-level *Construction Practicum* course in which students apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at http://www.tn.gov/education/cte/ArchitectureConstruction.shtml.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures. ~~(TN Reading 3, 4, 6; TN Writing 2, 4; NCCER 26102-14)~~

2) Continue to maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4; NCCER 26102-14)~~

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by

planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. (TN Reading 3, 4; NCCER 26102-14)

4) Describe hazards involved when working with electricity and determine procedures to safeguard against them in the workplace, including ensuring power load balance, adhering to the appropriate use of ground-fault circuit interrupters (GFCIs) when working with power tools, and performing lockout/tagout procedures. (TN Reading 3, 4; NCCER 26102-14)

Tools & Equipment

5) Identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the electrical industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency for a technician. (TN Reading 2, 3, 4; TN Writing 1, 9)

6) Distinguish among the various types and uses of electrical test equipment. Determine the appropriate test equipment for a given situation and environment and the procedures necessary for safe use. Utilizing test equipment such as a voltmeter, inspect and test an electrical wiring system for compliance according to drawings, specifications, and code requirements. (TN Reading 3, 4, 6; TN Math N-Q; TN Physical Science 2; TN Physics 5: NCCER 26112-14)

Construction Industry Principles

7) Locate and assess requirements for performing electrical work including local, state, and national requirements. Interpret electrical codes, and determine inspection procedures and other applicable portions of the law. Visit the Tennessee Contractor's Licensing Board's website and analyze its policies and requirements. Explain how such policies impact local construction businesses. (TN Reading 2, 3, 4, 9; TN Writing 7, 8; NCCER 26105-14)

8) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client, describing the services provided and explaining the project delivery method used by the company. (TN Reading 2, 3, 4, 5, 7, 8; TN Writing 2, 4; NCCER 44105-08)

National Electrical Code (NEC©)

9) Describe the purpose and layout of the National Electrical Code (NEC©). Create a chart to illustrate what is and is not covered by the NEC©, citing evidence from *NEC© Article 90*. Navigate, read, and interpret the NEC© to determine requirements for a given electrical installation. For example, interpret the NEC© to compare and contrast the box requirements for a device box to support a wall receptacle with those for a box to support a lighting fixture. (TN Reading 1, 2, 4, 6, 7, 9; TN Writing 2, 9; NCCER 26105-14)

Device Boxes

10) Distinguish among the various types of device boxes, such as metallic and nonmetallic device boxes. For a variety of given residential and/or commercial applications, select appropriate device boxes according to drawings, specifications, and code requirements. Steps should include identifying the proper box type and size; and determining the minimum size pull or junction box for conduit entering and exiting (both for a straight pull and at an angle). (TN Reading 3, 4, 6, 9; NCCER 26106-14)

11) Utilize the proper tools, equipment, and procedures to safely perform installation of a variety of device boxes according to drawings, specifications, and code requirements. (TN Reading 2, 3, 4; NCCER 26106-14)

Hand Bending

12) Describe the procedures, techniques, and tools for hand bending and installing conduit. Implement geometric principles to plan and use a hand bender to make 90 degree bends, back-to-back bends, offsets, kicks, and saddle bends. For example, use trigonometric ratios of right triangles to determine the offset angle of an offset bend and use the calculation to accurately create the bend. (TN Reading 3, 4; TN Math N-Q, G-RST; NCCER 26107-14)

13) Apply the appropriate tools, equipment, and procedures to safely cut, ream, and thread conduit. For example, ream the inside edge of a piece of conduit using a hand reamer. (TN Reading 3, 4; NCCER 26107-14)

Raceway Systems

14) Explain the function of raceway systems, including acting as a grounding conductor. Distinguish among the various types of raceways, fittings, and conduit bodies available for raceway systems. Analyze a given environment and select the appropriate materials and installation methods for a raceway system, citing evidence from textbooks and codes. For example, recommend the appropriate raceway materials and installation method for a wood frame building of given parameters, drawing on evidence from codes such as the National Electrical Code (NEC©). (TN Reading 2, 3, 4, 6, 9; TN Writing 2, 9; NCCER 26108-14)

15) Outline the methods and procedures used to install various raceway systems, including terminating conduit. Accurately connect conduit to a box according to code requirements, explaining the need for a proper connection based on grounding requirements and protection of the wires. Apply the appropriate tools and procedures to install flexible raceway systems. (TN Reading 2, 3, 4, 6; NCCER 26108-14)

Conductors & Cables

16) Building on knowledge of conductors from *Mechanical, Electrical, & Plumbing Systems*, read and interpret the NEC© and other instructional texts to determine the allowable ampacity of conductors for a variety of given applications. Include the insulation and jacket material, conductor size and type, number of conductors, temperature rating, and voltage rating of each.

Describe possible consequences of improper conductor selection or installation, citing evidence from resources such as textbooks or trade journals. (TN Reading 1, 2, 3, 4, 5; NCCER 26109-14)

17) Describe the proper methods and procedures for installing conductors in a raceway system, noting potential hazards that exist when conductors are installed incorrectly. Employ tools and procedures to safely install conductors in a raceway system and verify the installation is performed according to code requirements. (TN Reading 2, 3, 4, 6; TN Writing 2, 9; NCCER 26109-14)

Construction Drawings & Specifications

18) Building on knowledge of construction drawings and specifications from *Mechanical, Electrical, & Plumbing Systems*, read and interpret electrical drawings and specifications, including detail drawings and equipment schedules, to create a list of materials needed for a given electrical project. For example, analyze a lighting plan, light fixture schedule, and specifications for a residence to determine the materials needed to install the lighting system. (TN Reading 2, 3, 4, 6, 7; TN Writing 2, 9; TN Math N-Q; NCCER 26110-14)

19) Explain the relationship between construction drawings and specifications. For example, describe how both the construction drawings and specifications provide information about the raceway system indicated for a given building. Examine construction drawings and specifications to determine the requirements for a raceway system in a given building. (TN Reading 1, 2, 4, 5, 6, 7; NCCER 26110-14, 44105-08)

20) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI) as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product. (TN Writing 4; NCCER 44105-08)

Residential Electrical Services

21) Evaluate and recommend proper electrical hardware for a residential building. For example, for a residential dwelling with a given floor plan and schedule of major appliances, determine the size of the electrical service by referring to the National Electrical Code[©] and local code to select the service-entrance equipment, such as conductors, panelboard, and protective devices. Steps should include: calculating the load for lighting, small appliances, and large appliances; and determining the number of branch circuits required. Describe the installation rules pertaining to dedicated circuits as applied to various equipment such as ranges, dryers, and HVAC systems. (TN Reading 2, 3, 4, 7; TN Math N-Q; TN Physical Science 2; NCCER 26111-14)

Basic Maintenance & Repair Process

22) Identify and demonstrate basic troubleshooting strategies appropriate for evaluating electrical systems and devices. For example, in electrical systems, develop and implement a troubleshooting strategy to test and remedy an electrical fault. (TN Reading 3)

23) Identify routine maintenance procedures that should be performed on electrical systems for a given building. Create a timeline of recommended maintenance procedures for a client, justifying why each procedure is necessary by highlighting its preventive or cost-efficient characteristics. For example, create a schedule of tests to ensure emergency alarms are operating properly. (TN Reading 2, 3, 4, 7; TN Writing 4)

Introduction to Power Systems

24) Analyze typical electric power systems in a region by explaining how electricity is generated, transmitted, and distributed from a power plant to a given location. Describe different types of traditional power generation including fossil-fuel generation and nuclear energy. Explain the basic layout of the power grid and the function of its components, including substations and transformers. (TN Reading 2, 3, 4; TN Environmental Science 5; NCCER 49101-10)

25) Discuss the environmental impacts of generating and distributing electricity. Research alternate electric power systems, including but not limited to photovoltaic systems and wind power technologies. Describe the functions of the systems and analyze their use in regions across the country according to informational texts and technical specs. Compare and contrast at least three types of power generation systems in a written text, chart, or visual display. (TN Reading 2, 3, 4, 7; TN Writing 2, 9; TN Math N-Q; TN Environmental Science 5; NCCER 49101-10)

Business & Project Management

26) Describe the components and purpose of a basic contract document for a residential project, determining the meaning of key terms and other industry-specific words. Recognize the relationship and responsibilities of various parties to a contract. Write a basic contract for a construction job, such as an electrical service agreement for wiring work done for a residential client. (TN Reading 2, 3, 4, 5; NCCER 44105-08)

27) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals. (TN Reading 2, 6; TN Writing 2)

28) Interpret construction drawings and applicable national and local codes to determine the correct materials, tools, and equipment needed to complete a construction project. Plan and implement the steps needed to complete the project, adhering to inspection procedures and employing safe practices throughout. Draw from print and electronic examples to create a material list, cost estimation, project schedule, and inspection checklist for a project, applying the components of the documents to the given project. (TN Reading 2, 3, 9; TN Writing 4)

29) Produce clear and coherent writing for communication in the electrical industry. Create a service order for a given electrical project. Explain the service order to a peer, as would a service technician to a client. (TN Writing 4)

30) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during electrical projects as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule. (TN Reading 3; TN Writing 2, 4, 6, 10)

Portfolio

31) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Mechanical, Electrical, & Plumbing Systems*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Chemistry I: Tennessee Science: Chemistry I standard 2 may provide additional insight and activities for educators.
- TN Physics: Tennessee Science: Physics standard 2 may provide additional insight and activities for educators.
- TN Physical Science: Tennessee Science: Physical Science standards 1 and 2 may provide additional insight and activities for educators.
- TN Environmental Science: Tennessee Science: Environmental Science standard 5 may provide additional insight and activities for educators.
- NCCER Curriculum: National Center for Construction Education and Research

- o Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for NCCER Electrical Level One and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

HVAC

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6077
Prerequisite(s):	*Mechanical, Electrical, & Plumbing Systems* (6161)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is one of the third-level course options in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	EPA Section 608 Universal, Universal R-410A, HVAC Excellence Heating, Electrical, Air Conditioning Technology (H.E.A.T), HVAC Excellence Employment Ready Certifications
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	501, 502, 523, 532, 567, 592, 598, 701, 707
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

HVAC prepares students for careers in residential and commercial heating, ventilation, air conditioning, and refrigeration. Upon completion of this course, proficient students will be able to demonstrate knowledge and skill in performing basic operations with HVAC systems, with emphasis on safety, tools, and equipment specific to HVAC. In addition, students will be able to explain the functions and components of heating, cooling, and air distribution systems. They will demonstrate basic techniques to

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prepare piping and tubing for HVAC systems including performing soldering and brazing. Students will understand proper refrigerant management in preparation for EPA Section 608 Technician Certification. They will read and interpret drawings, specifications, and diagrams to determine materials needed to complete an HVAC project. Standards in this course also introduce basic troubleshooting and maintenance procedures and alternate power systems, and expand on principles of the construction industry, delving deeper into business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee State Standards in Chemistry I, Physics, Physical Science, and Environmental Science, as well as the National Center for Construction Education and Research (NCCER) Curriculum.*~~

Program of Study Application

This is one of the third-level course options available in the *Mechanical, Electrical, & Plumbing (MEP) Systems* program of study. This course can feed into a fourth-level *Construction Practicum* course in which students apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing these programs in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures. ~~(TN Reading 3, 4, 6; TN Writing 2, 4)~~

2) Continue to maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. Describe hazards involved with HVAC work, including working around refrigerants, oils, and gases. (TN Reading 3, 4)

Tools & Equipment

4) Identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the HVAC industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new tool could improve work efficiency for an HVAC technician. (TN Reading 2, 3, 4; TN Writing 1)

Construction Industry Principles

5) Locate and assess requirements for performing HVAC work including local, state, and national requirements. Interpret HVAC codes, and determine inspection procedures and other applicable portions of the law. Visit the Tennessee Contractor's Licensing Board's website and analyze its policies and requirements. Explain how such policies impact local construction businesses. (TN Reading 2, 3, 4, 9; TN Writing 7, 8)

6) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client, describing the services provided and explaining the project delivery method used by the company. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4; NCCER 44105-08)

HVAC and Electricity

7) Building on knowledge of electricity from *Mechanical, Electrical, and Plumbing Systems*, describe the functions of electrical components used in HVAC systems. Examine an electrical diagram of an HVAC system and interpret symbols to describe the system, distinguishing between load devices and control devices. For example, annotate a basic HVAC electrical diagram to explain the purpose and function of each component in the overall system to an entry-level HVAC technician. (TN Reading 2, 3, 4, 6, 7; TN Writing 2, 4; NCCER 03106-13)

Heating Systems

8) Building on knowledge of heat transfer from *Mechanical, Electrical, & Plumbing Systems*, describe the processes by which heat loss calculations are made for a residence. Describe a variety of ways in which heat is lost and why it is important for HVAC professionals to know how to perform heat loss calculations. For a given residence, follow procedures to perform a basic

heat loss calculation for a residence with a given u-value and location. (TN Reading 2, 3, 4, 5; TN Math A-SSE, N-Q; TN Physical Science 2; TN Physics 2; NCCER 03108-13)

9) Analyze various types of gas furnaces and explain how they operate. Describe the equipment and controls involved, the concept of combustion, the various gas fuels, and their combustion characteristics. Explain the proper procedures for installing and maintaining gas furnaces. Perform basic maintenance tasks on a gas furnace, including replacing air filters and measuring temperature. (TN Reading 2, 3, 4; TN Chemistry I 2; NCCER 03108-13)

10) Compare and contrast gas furnaces, hydronic heating systems, and electric heating systems by analyzing the operating procedures and pros and cons of each system. Write a recommendation for a heating system for a client with a given location and building type. Cite evidence from retail catalogues, manufacturers' specifications, and energy ratings to justify the recommendation, defending why the selected system is a better choice than an alternative solution. (TN Reading 1, 2, 3, 4, 5, 9; TN Writing 1, 9; NCCER 03108-13)

Cooling Systems

11) Describe the relationship between temperature and pressure and relate it to use of refrigerant in cooling systems. Distinguish between absolute pressure and gauge pressure. Summarize the processes involved in the basic mechanical refrigeration cycle, including the changes of state that occur and the basic patterns of the refrigerant flow. Analyze the major components of cooling systems and how they function, including compressors, condensers, evaporators, and controls. Draw evidence from textbooks, professional journals, and instructional websites to produce an explanation of the refrigerant cycle and the functioning processes of cooling systems in a written narrative with supporting graphics. (TN Reading 1, 2; TN Writing 2, 4, 6, 8, 9; TN Physical Science 1; TN Physics 2; NCCER 03107-13)

12) Utilize common measurement instruments including thermometers and gauge manifolds to measure temperature and pressure in an operating cooling system. Demonstrate the ability to calibrate a set of refrigerant gauges and thermometers, connect a refrigerant gauge manifold, and properly calculate subcooling and superheat on an operating system using the gauge manifold and a temperature probe. (TN Reading 3, 4; TN Math N-Q; TN Physical Science 1; TN Physics 2; NCCER 03107-13)

Refrigerant Management

13) Building on knowledge from *Mechanical, Electrical, & Plumbing Systems*, describe the impact of refrigerants on the environment and the laws and regulations that are in place to protect the environment, such as the Montreal Protocol, the Clean Air Act, and EPA technician certification requirements. Distinguish among the various types of refrigerant, identifying the properties and cylinder color codes of each type. Read and interpret safety precautions and regulations impacting the recovery, containment, handling, and disposal of refrigerants, including EPA regulations, manufacturer's technical bulletins and MSDSs, and transportation requirements established by the U.S. Department of Transportation (DOT), analyzing how requirements are structured in the text. For example, evaluate the condition of a refrigerant container and

determine if it meets DOT requirements, including proper labeling. Interpret unresolved or inadequately documented information. (TN Reading 1, 2, 3, 4, 5, 6, 7, 8, 9; NCCER 03301-13)

14) Describe the strategies and equipment used to leak test refrigerant circuits. Apply the appropriate tools, equipment, and procedures to safely pressurize a refrigerant system in preparation for leak testing and leak test the pressurized system. (TN Reading 2, 3; NCCER 03205-13)

15) Explain the various procedures used to recover, recycle, and reclaim refrigerant from equipment. Read and interpret technical documents to determine the required recovery level of a given HVAC system. Apply the appropriate tools, equipment, and procedures to safely perform refrigerant-recovery techniques while adhering to applicable regulations, including applying proper labeling and maintaining accurate records. Interpret and implement regulations surrounding the recycling, reclaiming, and disposing of refrigerant. (TN Reading 2, 3, 4; NCCER 03205-13)

16) Evaluate the purpose and procedures of system evacuation of an air conditioning system. Describe steps for selecting the appropriate tools to perform an evacuation for a given system. Compare and contrast common methods of evacuation such as deep vacuum and triple evacuation. Apply the appropriate tools, equipment, and procedures to safely perform a system evacuation. (TN Reading 3, 7, 9; NCCER 03205-13)

17) Explain and demonstrate how to properly charge various types of refrigerant circuits using different methods including by weight, by superheat, and by subcooling, safely employing the appropriate, tools, equipment and procedures. (TN Reading 3, 7; NCCER 03205-13)

Air Distribution Systems

18) Describe the physical principles involved in air distribution systems, including pressure, velocity, and volume. Recognize the various types and properties of mechanical equipment that make up an air distribution system, including various blowers, fans, duct materials, grilles, registers, and dampers. Analyze the design of a simple air distribution system (i.e., as found in a typical residence) and explain how the system functions, noting where physical principles can be observed. Create a visual display with supporting text to explain the functions of the system. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 9; TN Physical Science 1; NCCER 03109-13)

19) Research the purpose and importance of ventilation in modern HVAC systems. Use technology to create a brochure an HVAC technician could share with a client to illustrate the impact of proper ventilation on indoor air quality including services provided by the technician and steps the client can take to insure high indoor air quality. (TN Reading 1, 2, 4; TN Writing 2, 4, 6, 9; NCCER 03109-13)

20) Illustrate how the design and proper installation of an air distribution system impacts the energy efficiency of the system. Drawing on observations, supporting technical manuals, and resources such as those from the U.S. Green Building Council and EPA Energy Star, create an oral or written recommendation for a client outlining strategies to increase energy efficiency for the

HVAC system in a given building, such as properly sealing the ducts, dampers, and vent locations. (TN Reading 2, 3, 4, 5; TN Writing 4; TN Physical Science 1; NCCER 03109-13)

21) Utilize test equipment including tachometers, manometers, and velometers to analyze the performance of an air distribution system. For example, collect measurements with a velometer, apply the information to calculate the airflow volume in a duct, and report the findings using appropriate units. Read and interpret equivalent length charts and required air volume and duct size charts. (TN Reading 2, 3, 4; TN Math N-Q; TN Physical Science 1; NCCER 03109-13)

Basic Copper & Plastic Piping

22) Distinguish among different types of plastic pipe, fittings, and valves for use in HVAC, and select the correct support and spacing for HVAC plastic piping. Compare and contrast the tools, hazards, and procedures for cutting and joining various types of plastic pipe. Employ tools and procedures to safely measure, cut, and join plastic piping and fittings for HVAC. (TN Reading 2, 3, 4; TN Math N-Q; NCCER 03103-13)

23) Describe the properties of various types of copper tubing used for HVAC. Describe common fittings, hangers, and supports used in copper tubing. Demonstrate how to measure, cut, and bend copper tubing for HVAC systems while preparing the tubing to be joined. Demonstrate techniques for mechanically joining copper tubing, including flared connections compression connections. Prepare tubing for soldering and brazing by swaging, deburring, and cleaning a tube. Inspect completed joints by safely performing leak testing procedures. (TN Reading 2, 3, 4; TN Math N-Q; NCCER 03103-13)

Soldering & Brazing

24) Explain the purpose and process of soldering and brazing for an HVAC professional, outlining how the techniques work. Compare and contrast soldering and brazing, noting the uses, procedures, and equipment for each. Distinguish among the purposes, types, and uses of a variety of filler alloys and fluxes used in soldering and brazing, drawing on evidence from textbooks, manuals, and technical specifications to support claims. (TN Reading 2, 4, 9; NCCER 03104-13)

25) Describe the tools, equipment, and PPE used for soldering and brazing. Explain the safe operation of soldering and brazing equipment including assembling, testing, lighting, and shutting down acetylene and oxyacetylene equipment. Safely set up and shut down an acetylene single tank and oxyacetylene equipment. Describe and demonstrate procedures to safely prepare, solder, and braze copper tubing using various fittings. (TN Reading 2, 3, 4, 9; NCCER 03104-13)

26) Implement safe procedures to complete copper, brass, and steel tubing assemblies for a given layout. Steps include measuring, cutting, and fitting assemblies; choosing the proper filler alloys and fluxes for the assigned job; demonstrating proper use of acetylene and oxyacetylene equipment; and pressure testing assemblies to determine the proper completion of assemblies. (TN Reading 3; NCCER 03104-13)

Carbon Steel Piping

27) Describe the characteristics and uses of steel pipe, making note of the similarities and differences in steel piping, plastic piping, and copper tubing. Draw on evidence from textbooks and physical observations to support claims. (TN Reading 2, 9; NCCER 03105-13)

28) Analyze the classification and measurement of pipe threads. Describe the uses of different types of fittings used on steel pipe. Employ tools and procedures to safely measure, cut, thread, and ream steel pipe. (TN Reading 2, 3; NCCER 03105-13)

29) Explain and demonstrate the methods of installing, connecting, and mechanically joining steel pipe, including joining threaded pipe using fittings, pipe grooving methods, and assembling flanged steel pipe. (TN Reading 3; NCCER 03105-13)

Basic Maintenance & Repair Process

30) Identify and demonstrate basic troubleshooting strategies appropriate for evaluating HVAC systems, appliances, and devices. For example, develop and implement a troubleshooting strategy to test and remedy an undercharged system. (TN Reading 3)

31) Identify routine maintenance procedures that should be performed on HVAC systems for a given building. Create a timeline of recommended maintenance procedures for a client, justifying why each procedure is necessary by highlighting its preventive or cost-efficient characteristics. For example, create a schedule of items to inspect, clean, and replace in order to keep an HVAC system running efficiently. (TN Reading 2, 3, 4, 7; TN Writing 4; NCCER 03215-13)

Construction Drawings & Specifications

32) Explain the relationship between construction drawings and specifications. Describe how both the construction drawings and specifications provide information about the HVAC system for a building. For example, examine construction drawings and specifications to determine the requirements for hangers and supports in a given HVAC piping system. (TN Reading 1, 2, 4, 5, 6, 7; NCCER 44105-08)

33) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI), as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product. (TN Writing 4; NCCER 44105-08)

Business & Project Management

34) Describe the components and purpose of a basic contract document for a residential project, determining the meaning of key terms and other industry-specific words. Recognize the relationship and responsibilities of various parties to a contract. Write a basic contract for a job, such as a HVAC service agreement for work done for a residential client. (TN Reading 2, 3, 4, 5; NCCER 44105-08)

35) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals. (TN Reading 2, 6; TN Writing 2)

36) Interpret construction drawings and diagrams to determine the correct materials, tools, and equipment needed to complete an HVAC project. Plan and implement the steps needed to complete the project, adhering to inspection procedures and employing safe practices throughout. Draw from print and electronic examples to create a material list, cost estimation, schedule, and inspection checklist for a project, applying the components of the documents to the given project. (TN Reading 2, 3; TN Writing 4)

37) Produce clear and coherent writing for communication in the HVAC industry. Create a service order for a given HVAC project. Explain the service order to a peer, as would a service technician to a client. (TN Reading 4; NCCER 03215-13)

38) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during HVAC projects as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule. (TN Reading 3; TN Writing 2, 4, 6, 10)

Portfolio

39) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Mechanical, Electrical, & Plumbing Systems*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.

- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Chemistry I: Tennessee Science: Chemistry I standard 2 may provide additional insight and activities for educators.
- TN Physics: Tennessee Science: Physics standard 2 may provide additional insight and activities for educators.
- TN Physical Science: Tennessee Science: Physical Science standards 1 and 2 may provide additional insight and activities for educators.
- TN Environmental Science: Tennessee Science: Environmental Science standard 5 may provide additional insight and activities for educators.
- NCCER Curriculum: [National Center for Construction Education and Research](#)
  - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for NCCER HVAC Level One and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Construction Practicum

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code:	6160
Prerequisite(s):	Minimum of 2 credits in an Architecture & Construction program of study.
Credit:	1
Grade Level:	12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the fourth course in the *Residential & Commercial Construction*, *Structural Systems,* and *Mechanical, Electrical, and Plumbing Systems* programs of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	501, 502, 522, 523, 524, 527, 532, 553, 554, 555, 556, 567, 575, 580, 584, 585, 592, 598, 701, 702, 703, 705, 706, 707
Required Teacher Certifications/Training:	If students are assigned in work-based learning settings, teachers must attend WBL training and earn the WBL Certificate provided by the Tennessee Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Construction Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous Architecture & Construction courses within a professional, working environment. In addition to developing an understanding of the professional and ethical issues

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encountered by tradesmen and contractors in the workplace, students learn to refine their skills in problem solving, communication, teamwork, and project management in the completion of a course-long project. Due to the importance of on-the-job training in the construction industry, a principle aim of the practicum is to assist students with placements where on-the-job training occurs, if available, so they can begin to log hours on a worksite and gain experience prior to entering the job market, such as in pre-apprenticeships. Additionally, students are exposed to the great range of postsecondary opportunities in today's construction fields as well, in order to prepare them to make an informed decision regarding their post-high school plans.

The course is highly customizable to meet local system needs. Instruction may be delivered through work-based learning arrangements such as internships, cooperative education, service learning, mentoring, and job shadowing or through school laboratory training with industry-driven project-based learning. For all projects undertaken in this course, students are expected to continue building skills related to their chosen program of study (*Residential & Commercial Construction, Structural Systems, or Mechanical, Electrical, & Plumbing Systems*), while also refining skills previously acquired to achieve deeper levels of mastery. In the course, students may pursue additional training and certification in a specialized area such as masonry, concrete, electricity, plumbing, HVAC, or carpentry. Upon completion of the practicum, proficient students will be prepared to pursue further study in architecture or construction, or seek additional training and employment with the aid of a portfolio documenting student work completed throughout high school. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, and Tennessee State Standards in Mathematics.*~~

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Residential & Commercial Construction*, *Structural Systems,* and *Mechanical, Electrical, and Plumbing Systems* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. (TN Reading 3, 4, 6)

2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. (TN Reading 3, 4)

3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. (TN Reading 3, 4)

4) Research state and national laws governing workplace injuries, particularly those common to the construction industry. In preparation for a future career in construction, outline the necessary procedures to follow if an injury is sustained on the job; in particular, explain the responsibilities of managers, supervisors, and the injured parties in the event of an emergency, including incident reporting after the event. Practice explaining the process of securing workers compensation benefits as if assisting a co-worker or subordinate. (TN Reading 1, 2, 8)

Postsecondary and Career Preparation

5) Research the range of credentials one can earn with advanced study of construction at the postsecondary level (i.e., apprenticeship, technical certification, BA, BS, MBA, etc.). Investigate both in-state and out-of-state postsecondary programs in a variety of construction fields, including but not limited to construction management, construction science, architecture, landscape design, civil engineering, and more. Synthesize research conducted in previous Architecture & Construction courses to update the portfolio career plan to achieve post-high school goals. (TN Reading 5, 7, 9; TN Writing 4, 6, 8, 9)

6) Research and select a company or organization for a project in a construction field. Cite specific textual evidence from the organization's literature, as well as independent news articles, to summarize:

       a. The mission and history of the organization
       b. Headquarters and organizational structure
       c. Products or services provided
       d. Credentials required for employment and how they are obtained and maintained
       e. Policies and procedures
       f. Reports, newsletters, and other documents published by the organization
       g. Website and contact information
(TN Reading 1, 2; TN Writing 4, 7)

7) Search for the resumes of construction professionals retrieved from the websites of companies, organizations, or professional networks. Discuss what is typically included in the resumes of these professionals, compare and contrast several examples, and create a personal resume modeled after elements identified in the search. (TN Reading 1, 4, 5, 6; TN Writing 4)

8) Simulate the experience of conducting a job search by researching local employment options. In preparation for a future career in construction, complete an authentic job application form and compose a cover letter following guidelines specified in the vacancy announcement. (TN Reading 7; TN Writing 4)

9) Participate in a mock interview. Prior to the interview, research tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Highlight sample work compiled in the portfolio that illustrates mastery of specific skills attained in the program of study. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. (TN Reading 2; TN Writing 2, 4, 7, 9)

Transferring Course Concepts to Practicum

10) Apply skills and knowledge from previous courses in an authentic work-based learning internship, job shadow, or classroom-based project. Where appropriate, develop, practice, and demonstrate skills outlined in previous courses. (TN Reading 2, 3)

11) As part of a course project, develop a comprehensive project plan, appropriate to the project type, to guide all work. The plan should include at minimum the following:
       a. Material list
       b. Cost estimation/Mock bid package
       c. Criteria and constraints
       d. Project schedule
       e. Inspection checklist
       f. Applicable contracts
       g. Minutes from project meetings and other documentation
       h. Contingency plan in case of delay or emergency
       i. Justification for major design and budgeting decisions made
Collaboratively update the plan to reflect unexpected changes in conditions or capacity. For example, demonstrate the ability to reschedule an activity if there is a delay in the arrival of materials. (TN Reading 3, 4, 7, 9; TN Writing 1, 4, 5, 7)

12) Create and continually update a personal journal to document skills learned during the practicum and draw connections between the experience and previous course content by reflecting on:
   a. Tasks accomplished and activities implemented
   b. Positive and negative aspects of the experience
   c. How challenges were addressed
   d. Team participation in a learning environment
   e. Comparisons and contrasts between classroom and work environments
   f. Interactions with colleagues and supervisors
   g. Personal career development
   h. Personal satisfaction
   (TN Writing 2, 4)

Business Skills and Project Management

13) In teams, develop and successfully implement a suite of project management tools and processes to aid in the completion of the course project. (If participating in a work-based learning experience, apply tools and processes to satisfy placement requirements.) Demonstrate the ability to divide roles and responsibilities among team members, track progress toward goals, and satisfy client specifications as would a construction manager or contractor. For example, assign tasks and monitor deliverables using a Gantt chart or other tracker.

Portfolio

14) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* to illustrate mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of project management skills specific to the construction industry. The following documents will reside in the career portfolio:
   a. The career plan developed and revised in prior courses
   b. Resume
   c. List of responsibilities undertaken through the course
   d. Examples of visual materials used during the course (such as diagrams, schematics, and site plans) and artifacts of project outcomes (such as photographs of various stages of a construction project)
   e. Periodic journal entries reflecting on tasks and activities
   f. Feedback from instructor and/or supervisor based on observations
   g. Transcripts or other evidence of certifications obtained throughout the program of study
   (TN Writing 4, 5)

Communication of Project Results

15) Apply all steps of the construction process to successfully build a structure and/or install a system(s) as outlined in the course project plan. Demonstrate the ability to communicate results over the course of the project's duration. Produce a technical report documenting the progress of the project and evaluating the final product. (TN Reading 3, 7, 9; TN Writing 2, 4, 5, 6, 7, 9)

16) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, drawings, videos, photographs, and/or guided tours of the finished structure or product. Throughout the presentation, justify construction decisions and assess the quality of the work. Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Geometry.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. While not aligned to one specific conceptual category, students who are engaging in the activities outlined above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Architectural & Engineering Design I

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6037
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the first course in the *Architectural & Engineering Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 470, 477, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 705, 740, 760, or any other Occupational License endorsement with ADDA certified drafter or Autodesk certification
Required Teacher Certifications/Training:	ADDA Certified Drafter or Autodesk Certified Professional
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Architectural & Engineering Design I is a foundational course in the Architecture & Construction cluster for students interested in a variety of engineering and design professions. Upon completion of this course, proficient students will be able to create technical drawings of increasing complexity, and utilize these skills to complete the design process and communicate project outcomes. Students will build

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foundational skills in freehand sketching, fundamental technical drawing, and related measurement and math. Standards in this course also include career exploration within the technical design industry, as well as an overview of the history and impact of architecture and engineering. In addition, students will begin compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the foundational course in the *Architectural & Engineering Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Introduction to Architecture & Engineering Design

3) Investigate the evolution of architecture and engineering across a variety of civilizations throughout history. Identify major innovations, such as technological advances in materials or construction processes. Synthesize research from textbooks and other resources to create an annotated timeline or visual graphic illustrating significant time periods in the development of architecture and engineering. ~~(TN Reading 2, 4, 7; TN Writing 2, 4)~~

4) Research and summarize in a clear and coherent informational artifact (e.g., a brochure, poster, fact sheet, narrative, or presentation) the influences and contributions of a selected architect or engineer. Cite resources and examples of the individual's completed work to illustrate their impact on society. ~~(TN Reading 2, 4; TN Writing 2, 4)~~

5) Investigate the social, economic, and environmental impact of decisions made by architects and engineers at the local, national, and global levels. Provide a detailed description of the impacts of a specific discipline, citing links to relevant websites to illustrate the ideas presented. For example, describe how structural engineers design structural systems in buildings to protect occupants from earthquakes and tornadoes, and illustrate how the materials selected by the engineer impact the environment and economy. ~~(TN Reading 1, 2, 5; TN Writing 2, 4, 6, 7, 9)~~

6) Research the principles of sustainable design. Examine a case study of an energy efficient building and determine whether the principles of sustainable design are illustrated in the design of the building. Assess whether the evidence presented is strong enough to support claims of sustainability, and compile a brief persuasive narrative summarizing conclusions. (TN Reading 2, 4, 8; TN Writing 1, 9)

Career Exploration

7) Research the major professions in architecture and engineering, such as a civil engineer, mechanical engineer, industrial engineer, electrical engineer, engineering technician, architect, and more. Cite supporting evidence from multiple sources (such as interviews with design professionals retrieved from industry magazines). Produce a chart or other graphic detailing the aptitudes and training needed for at least three careers of interest. For example, outline the typical requirements needed to become a civil engineer, including personal aptitudes, secondary and postsecondary training, and licensing. Devise a tentative career plan to reach employment goals. (TN Reading 1, 2, 3, 4, 7; TN Writing 2, 9)

8) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to investigate local and regional occupational opportunities and trends in architectural and engineering careers. Synthesize collected data to develop a graphic illustration comparing occupations by job availability, salaries, and benefits. (TN Reading 2, 4, 7; TN Writing 7, 9; TN Math S-ID)

Design Process

9) Research design processes used by architects and engineers. Drawing on multiple resources, explain the steps to the design process in a written narrative, synthesizing a range of perspectives on the process as practiced in a variety of architectural and engineering disciplines. Explain why it is an iterative process and always involves refinement. (TN Reading 3, 4, 5; TN Writing 2, 8)

10) Evaluate an existing design created by architects and/or engineers using the design process such as a building, landscape, bridge, or product. Produce a report on the chosen design, describing how the design team likely progressed through each step of the design process citing examples from design magazines and other resources. Examples should include design constraints encountered by the design team and criteria for measuring the effectiveness of the design. (TN Reading 1, 2, 3, 4, 6; TN Writing 2, 9)

Sketching

11) Investigate the use of sketching in the creative design process. Drawing from resources, explain the tools and techniques used and when architects and engineers apply sketching in the design process. (TN Reading 3, 4, 5, 7; TN Math G-MG)

12) Create freehand sketches, including rough and refined sketches, demonstrating techniques for sketching freehand lines and circles while attending to accurate proportion. Produce pictorial sketches applying shading techniques. Simulate sketching techniques used by engineers and architects on jobsites by sketching live objects to create field sketches. Utilize hand lettering

techniques to neatly add notes to the sketches. (TN Reading 3, 4, 7; TN Writing 4; TN Math G-GMD, G-MG)

13) Develop conceptual design ideas using freehand sketching. For example, for a given design problem, generate, analyze, and refine sketches to develop design solutions. Use the sketches to further develop a chosen design and create refined drawings. (TN Reading 3, 4, 7; TN Writing 4, 5, 9; TN Math G-GMD)

Fundamental Technical Drawing

14) Interpret a technical narrative to understand the steps and tools needed to create geometric constructions such as bisecting a line, angle, or arc; using lines, circles, and arcs to draw a polygon such as a pentagon or hexagon; and constructing tangent and perpendicular relationships. Use geometric terms, illustrations, and supporting texts to describe the steps of creating a geometric construction with accuracy. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-CO, G-C, G-MG)

15) Create accurate manual single-view scale drawings of advancing complexity, incorporating symbols, notes, and dimensions, using appropriate layout within title blocks, drawing composition (including line weight and line type), geometric construction techniques, and lettering techniques. For example, create a drawing of a metal plate at half scale using an engineer's scale and other tools. After more practice, create a floor plan of the classroom at quarter scale using an architect's scale and other tools. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-CO, N-Q, G-MG)

16) Interpret and apply dimensioning rules to accurately label dimensions on drawings including arranging dimensions, using various dimension styles (such as aligned and angular), and avoiding redundancy. Drawing on evidence from textbooks and industry standards (such as the American National Standards Institute and the American Society of Mechanical Engineers), create an infographic an engineer or architect could use as a guide to appropriately employ basic dimensioning rules. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4)

17) Create accurate multi-view scale drawings of objects of advancing complexity using orthographic projection. Incorporate symbols, notes, dimensions, and different types of lines (such as hidden lines to show internal or hidden features). Demonstrate procedures to establish a principle view of an object and project from an existing view to create additional views. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

18) Building on the knowledge of a single view and multi-view drawing, create simple isometric drawings, properly using lines, labels, and dimensioning techniques. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-GMD, G-MG)

19) Define the differences in technique among freehand sketching, manual drafting, and computer-aided drafting (CAD). Describe the skills required for each and how each type is used in industry, citing specific examples. Create a visual display with accompanying text comparing and contrasting at least two techniques. (TN Reading 2, 3, 4, 5, 9; TN Writing 2, 4)

20) Interpret instructional material to use CAD software to create simple two-dimensional drawings, accurately incorporating symbols, dimensioning, and line types. Instructional material may include textbooks, manuals, websites, video tutorials, and more. Perform basic operations such as creating files, saving files, opening files, storing files, and printing. Set up the drawing environment by inserting title blocks, applying settings (ortho, snap, etc.), and assigning line weights, line types, and colors. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

21) Demonstrate the ability to refine drawings based on critique from peers, instructors, and self-evaluation. Drawing on evidence from textbooks and other resources, evaluate the effectiveness of a drawing based on industry standards for technical drawing. Interpret and incorporate feedback when refining drawings. (TN Reading 2, 3, 4, 6, 7; TN Writing 5, 9)

Measurement & Math

22) Apply mathematics concepts to create drawings and solve design problems in this course, distinguishing which principles apply to a given design problem. Concepts should include, but are not limited to:
   a. Determining and applying the equivalence between fractions and decimals. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch. (TN Math N-Q)
   b. Working with units such as feet, inches, meters, centimeters, and millimeters, and determining appropriate units for a given construction task. For example, convert a dimension from centimeters to inches. (TN Math N-Q)
   c. Calculating perimeter, area, volume, and surface areas of objects employing related geometric terminology. (TN Math G-GMD, G-MG)
   d. Performing proportionate reasoning to estimate quantities, such as determining the appropriate scale for a drawing and a given sheet size. (TN Math N-Q)
   e. Using basic rules of right triangles, such as the Pythagorean Theorem, to find missing lengths. (TN Math G-SRT)

23) Use customary and metric measurement systems to complete accurate field measurements. Determine the appropriate units and record accurate measurements of lengths and angles using proper tools. Tools should include, but are not limited to: fractional rule, metric rule, measuring tape, architect's scale, engineer's scale, dial caliper, and protractor. (TN Reading 3; TN Math N-Q)

24) Use field measurements to create a drawing, accurately representing the true layout. For example, create a scale drawing of a simple mechanical device by taking field measurements of the device, determining the appropriate scale, and using an engineer's scale to accurately draw the device. (TN Reading 3, 4; TN Writing 2, 4; TN Math N-Q, G-MG)

Design Project

25) Use the design process to create a solution for a given design problem, selecting and creating appropriate drawings to explain the solution, including sketches and multiple views of two-dimensional scale drawings. Prepare an informative narrative to explain how each step of the design process was followed to complete the project. Emphasize the key characteristics of the design which make it an appropriate solution for the given constraints. (TN Reading 3, 4, 5, 7; TN Writing 2, 4; TN Math N-Q, G-MG)

Portfolio

26) Compile important artifacts to create a portfolio connecting personal career preparation to concepts learned in this course, including written descriptions of drawing types and learning outcomes. Continually review and revise documents, using technology as needed. ~~(TN Writing 4, 5, 6, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry, and Statistics (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Architectural & Engineering Design II

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6039
Prerequisite(s):	*Architectural & Engineering Design I* (6037)*, Algebra I* (0842, 3102)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the second course in the *Architectural & Engineering Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 470, 477, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 705, 740, 760, or any other Occupational License endorsement with ADDA certified drafter or Autodesk certification
Required Teacher Certifications/Training:	ADDA Certified Drafter or Autodesk Certified Professional
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Architectural & Engineering Design II is the second course in the *Architectural & Engineering Design* program of study. Students in this course build their skills in developing and representing design ideas using technical drawing and modeling techniques, and apply the design process to solve design problems. Upon completion of this course, proficient students will be able to use computer-aided

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drafting (CAD) software to create multi-view, sectional view, auxiliary view, and three-dimensional drawings using industry standard dimensioning and notation. Students will connect drawings with actual physical layouts by building models based on drawings, creating drawings based on objects and other physical layouts, and using software to create basic three-dimensional models. In addition, students will continue compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Architectural & Engineering Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Career Exploration

3) Research the postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer architecture or engineering programs. Write an informative paper or develop an infographic identifying admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare individuals to be successful in a postsecondary architecture or engineering program. Evaluate the tentative career plan developed in the introductory course in light of these findings, and update the career plan to reflect any new discoveries, citing evidence from the research. ~~(TN Reading 1, 2, 3, 5; TN Writing 2, 4, 7, 9)~~

Advanced Technical Drawing

4) Use computer-aided drafting (CAD) software to create two-dimensional drawings of advancing complexity, accurately incorporating symbols, notes, dimensioning, and line types to design drawings. Perform software operations such as utilizing sheets/layouts for printing, scaling viewports in sheets/layouts for printing, printing drawings to proper scale, outputting drawings

to electronic and paper media, and overlaying drawings on externally-referenced drawings. ~~(TN Reading 3, 4; TN Math G-MG)~~

5) Use CAD software to create accurate multi-view drawings of objects of advancing complexity using orthographic projection, incorporating symbols, notes, dimensions, and line type (such as hidden lines to show internal or hidden features). ~~(TN Reading 3, 4; TN Math G-MG)~~

6) Use CAD software to create pictorial drawings of advancing complexity, such as isometric, oblique, and perspective drawings. Attend to detail by using proper angles and ensuring holes, cylinders, prisms, and other features are in proper alignment and relationship to each other. Incorporate symbols, notes, dimensions, and line type according to industry standards. ~~(TN Reading 3, 4; TN Math G-GMD, G-MG)~~

7) Create accurate sectional view drawings of advancing complexity (such as full, half, offset, broken-out, removed, and revolved sections), incorporating symbols, notes, and dimensions, using appropriate layout within title blocks, and appropriate drawing composition (including line weight and line type). For example, create a full section drawing of a mechanical part, hatching appropriate surfaces and using notation to indicate the cutting plane. ~~(TN Reading 3, 4; TN Math G-GMD, G-MG)~~

8) Create accurate auxiliary view drawings of advancing complexity including depth, height, or width auxiliary views; partial auxiliary views; and auxiliary section views. ~~(TN Reading 3, 4; TN Math G-GMD, G-MG)~~

9) Draw detailed, schematic, and simplified drawings of various types of threads and fasteners, including unified, square, and acme threads. Demonstrate the ability to accurately interpret industry-standard thread notes to calculate the thread pitch as well as lay out and construct the drawing. ~~(TN Reading 3, 4; TN Math N-Q, A-CED, G- GMD, G-MG)~~

10) In teams, produce a complete set of project drawings including a completed assembly drawing and an exploded assembly drawing. Supplement assembly drawings with appropriate representations of individual components and a bill of materials as needed for the project type. Fully describe the design by selecting the most appropriate drawing type for the given component, including plan, section, and three-dimensional drawings. ~~(TN Reading 3, 4; TN Math G-MG)~~

11) Demonstrate the ability to refine drawings based on critique from peers, instructors, and self-evaluation. Drawing on evidence from textbooks and other resources, evaluate the effectiveness of a drawing based on industry standards for technical drawing. Interpret and incorporate feedback when refining drawings. ~~(TN Reading 2, 3, 4, 6, 7; TN Writing 5, 9)~~

Dimensioning

12) Interpret industry standards to accurately apply dimensions, notes, and symbols on CAD drawings, including arranging dimensions, using various dimension styles and symbols, and avoiding redundancy. Demonstrate the ability to adjust annotation styles and sizes based on the

drawing type and scale. Define tolerance and give examples of general methods for noting tolerances on drawings. (TN Reading 3, 4; TN Math G-MG)

13) Research the American National Standards Institute (ANSI) and describe the goals of the organization and the impact it has on technical drawing, particularly for dimensioning a drawing. (TN Reading 2, 3, 4, 5, 7)

Introduction to Three-Dimensional Modeling

14) Use three-dimensional modeling software to create a simple three-dimensional model. Interpret instructional materials to perform basic operations using three-dimensional modeling software. Instructional materials may include textbooks, instructional manuals, websites, video tutorials, and more. (TN Reading 2, 3, 4, 6, 7; TN Math G-GMD, G-MG)

Applications of Technical Drawing

15) Understand how designs are communicated through different types of two-dimensional and three-dimensional drawings, physical models, and virtual three-dimensional models within various disciplines, such as architectural, civil, mechanical, electrical, and industrial design. Interpret symbols and notations within the context of each type. Use technology to create a visual display with supporting text to compare and contrast how different drawing types covered in the coursework are implemented in a variety of disciplines, drawing from examples in textbooks, industry journals, drawings created during the coursework, and other resources. For example, illustrate how the plan, orthographic projections, and section drawings of a residence compare with those of a machine part. (TN Reading 1, 2, 4, 7; TN Writing 2, 6, 9)

16) Interpret technical drawings to build a physical model of a design. Select and use the appropriate materials and tools to safely measure components and construct the model. Upon completion, use the technical drawings to check the model for accuracy. (TN Reading 2, 3, 4, 6, 7; TN Math N-Q; G-GMD, G-MG)

17) Building on techniques practiced in the introductory course, continue to measure, record, and use field measurements to create drawings of increasingly complex objects and layouts. For example, create an accurate half section drawing of an actual mechanical gear by measuring and examining the physical object in order to visualize and draw the section. (TN Reading 3, 4; TN Writing 2, 4; TN Math N-Q, G-MG)

18) Create two-dimensional plans for a simple three-dimensional object utilizing drawing techniques learned in the course, such as auxiliary drawing. Use the plans to build a rough study model of the object. Evaluate the model and revise the design on the basis of collected test data. For example, create a two-dimensional drawing of three-dimensional sheet metal design or package design as if the object were unfolded. Print the drawing on paper and construct a paper model of the object. Evaluate the model for inaccuracies and identify opportunities to improve efficiency of materials or construction. Use these conclusions to refine the design. (TN Reading 3, 4; TN Math N-Q; G-GMD, G-MG)

Technology

19) Identify and demonstrate basic troubleshooting strategies related to fundamental hardware and software problems. Evaluate electronic media to diagnose and fix hardware and software problems encountered during the coursework. For example, consult software forums, tutorial videos, and other instructional materials to diagnose and correct a drawing that prints on paper differently than intended. (TN Reading 2, 3, 4, 5, 9)

20) Explain how technology has changed design throughout history, and identify current transitions occurring in design media, technique, and focus. Read and interpret trade journals, assessing the usefulness of each source, to describe the impact technology has had on a particular design discipline. For example, cite evidence from trade journals to explain the impact of three-dimensional printing on industrial engineering practices or the impact of building information modeling software on structural engineering practices. (TN Reading 1, 2, 3, 4, 5; TN Writing 2, 8, 9)

Projects

21) Develop a project plan and use the design process to create a solution for moderately complex problem sets, utilizing both simple three-dimensional modeling techniques and detailed technical two-dimensional and three-dimensional scale drawings. Prepare a persuasive narrative to justify the design, describing the constraints of the design and defending how the design solves the identified problem(s). At the completion of the design process, publish the narrative and design and present the design to an audience, receive feedback, and critique the designs of other classmates. (TN Reading 3, 4, 5, 7; TN Writing 1, 4, 6; TN Math N-Q, G-MG)

22) Choose between alternate design solutions for a given design problem and justify the choices. Make a written case for selecting one design over another, highlighting the design features of each and citing resources to validate claims. Demonstrate the ability to pitch the idea to the client in a presentation, defending the design by pointing to specific features that meet the client's specifications. (TN Reading 1, 2, 4, 6, 7, 8; TN Writing 1, 4, 9)

Portfolio

23) Update materials from coursework to add to the portfolio begun in the introductory course. Continually reflect on coursework experiences and revise and refine the career plan generated in the introductory course. Include written descriptions of drawing types and learning outcomes. (TN Writing 4, 5, 7, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, and Geometry (pages 58-83).~~
  - o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Architectural & Engineering Design III

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	5927
Prerequisite(s):	*Architectural & Engineering Design II* (6039)*, Geometry* (0843, 3108)
Credit:	1-2 credits (see Recommended Credit below)
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the third course in the *Architectural & Engineering Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 157, 230, 470, 477, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 705, 740, 760, or any other Occupational License endorsement with ADDA certified drafter or Autodesk certification
Required Teacher Certifications/Training:	ADDA Certified Drafter or Autodesk Certified Professional
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Architectural & Engineering Design III is the third course in the *Architectural & Engineering Design* program of study. In this advanced course, students will apply technical drawing and design skills developed in the previous courses to specific architectural and mechanical design projects and contexts. In the process, students will expand their problem-solving and critical-thinking skills by assessing the

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requirements of a project alongside the available resources in order to accomplish realistic planning. Upon completion of this course, proficient students will be able to employ methods of data collection and analysis to provide others with appropriate information for projects and to develop their own designs. Students will also be able to engage with industry-specific technology to create visual representations of project outcomes. In addition, students will continue compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the third course in the *Architectural & Engineering Design* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one credit or two credits, this course can feed into a fourth-level *Engineering Practicum* course in which students can apply the skills learned toward the completion of an in-depth, semester- or year-long project. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Recommended Credit

If all standards in the course are covered, the course is recommended for two credits. If only one credit is to be offered, the following two options are recommended:

1 Credit- Option A

Content	Standards
Safety	1, 2
Architectural Design	3, 4, 5, 6, 7, 8, 9, 10
Research Project	16
Design Project	17, 18, 19
Project Management	20, 21, 22
Portfolio	23

1 Credit- Option B

Content	Standards
Safety	1, 2
Mechanical Design	11, 12, 13, 14, 15
Research Project	16
Design Project	17, 18, 19
Project Management	20, 21, 22
Portfolio	23

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. (TN Reading 3, 4, 6)

2) Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)

Architectural Design

3) Interpret civil drawings used to describe a site, including recognizing symbols used to describe topography. For example, in teams, interpret a topographic survey drawing to construct a model (physical or virtual) of a building site. Use the model to influence the design of the building and the building's placement on the site. (TN Reading 3, 4, 5, 6; TN Math N-Q, G-GMD, G-MG)

4) Perform a site analysis to make design decisions for a building plan, including interpreting existing site conditions and evaluating site surroundings. Determine the impact environmental factors such as climate, wind patterns, and the movement of the sun have on the design and site placement of the building. Summarize site analysis findings with drawings and supporting text. (TN Reading 2, 3, 4, 5, 7; TN Writing 4, 9)

5) Synthesize the various constraints affecting a building's design to make and justify design decisions. Items to consider should include:
    a. Evaluating the building's program based on client need. For example, appraise the requirements of the client such as total square footage and list of desired features (number of bedrooms, bathrooms, etc.).
    b. Accommodating the needs of people of all ages and physical abilities in compliance with the Americans with Disabilities Act (ADA).
    c. Interpreting applicable building codes based on the project type. For example, determine the minimum number and spacing of exit doors for a given building occupancy size.
    (TN Reading 2, 4, 6)

6) Research planning and diagramming techniques used by designers. Implement planning and diagramming techniques such as bubble diagrams and traffic flow patterns to design a schematic site plan and floor plan for a given building program. (TN Reading 2, 3, 4, 7)

7) Create a properly scaled model of a building (physical or virtual) and study the model in the context of the site layout. Present the model along with supporting sketches and diagrams to an audience (such as the instructor and peers), explaining and justifying design ideas in a logical, coherent narrative. Gather feedback and use it to refine the design. (TN Reading 3, 4, 7; TN Writing 2, 4, 5, 9)

8) Incorporate schematic design sketches, models, and peer feedback to further develop a building's design. Communicate details of the design through appropriate drawing types, utilizing industry-standard drawing conventions and software. Create a comprehensive set of drawings including the following drawing types:
   a. Site plan
   b. Floor plan
   c. Interior and exterior building elevations
   d. Foundation plan
   e. Roof plan
   f. Building system plans (such as an electrical plan)
   g. Door and window schedules
   h. Three-dimensional renderings (interior and exterior)
   (TN Reading 3, 4, 7; TN Math N-Q, G-GMD, G-MG)

9) Research sustainable design solutions and practices; then provide recommendations for a given design. Calculate a rating for energy responsiveness using a sustainable building guideline. (TN Reading 2, 3, 4, 6; TN Writing 7, 9)

10) Examine a wall section drawing for a specific building. Identify, define, and explain the function of each component, including wall insulation, flashing, and the structure of the cornice. Draw from textbooks and other resources to annotate the wall section drawing with notes explaining the purpose of each component. (TN Reading 1, 2, 3, 4; TN Writing 2, 4, 9)

Mechanical Design

11) Create three-dimensional models of machine parts of increasing complexity utilizing parametric modeling software. Perform software operations including:
   a. Utilizing basic software tools such as extruding and cutting, and navigating around the object.
   b. Applying and modifying geometric constraints and dimensions to capture and alter the design geometry of a part.
   c. Creating drawing layouts with dimensioned views of parametric solids, arranging a drawing sheet according to industry standards.
   d. Printing drawing layouts at appropriate scales.
   e. Preparing multi-sheet working drawings and assembly drawings according to industry standards.
   (TN Reading 2, 3, 4; TN Math N-Q, G-GMD, G-MG)

12) Building on techniques practiced in prior courses, continue to measure, record, and use field measurements to create drawings of increasingly complex objects and layouts. For example, create an accurate three-dimensional model of an actual screw and fastener by first measuring and examining the physical object in order to visualize and create the model. (TN Reading 3, 4; TN Math N-Q, G-MG)

13) Compile parametric models of individual machine parts to create a model of a simple assembly. Perform advanced software operations such as animating the model to illustrate how the assembly operates. (TN Reading 3, 4; TN Math N-Q, G-GMD, G-MG)

14) Utilize the design process to create a schematic design solution for a mechanical design problem. Identify the criteria and constraints and produce a virtual or physical model of the solution, utilizing software tools where appropriate. Test and evaluate the solution by performing an analysis of the model and gathering feedback from peers. (TN Reading 2, 3, 4; TN Math N-Q, G-GMD, G-MG)

15) Incorporate schematic design models, peer feedback, and test results to further develop a design. Communicate details of the design through appropriate drawing types, utilizing industry standard drawing conventions and software. Derive working drawings (detail and assembly drawings including parts lists) from the three-dimensional models created using parametric modeling software. Attend to details when explaining the design, including:
    a. Specifying and depicting threads, fasteners, and other hardware involved in a mechanical assembly.
    b. Applying appropriate geometric dimensioning and tolerancing based on industry standards, including understanding tolerance relationships between mating parts, interpreting geometric tolerancing symbols in a drawing, and using tolerancing in drawings.
    c. Selecting and creating appropriate section drawings, noting tolerances, hidden surfaces, and other mechanical details.
    (TN Reading 2, 3, 4, 7; TN Math N-Q, G-GMD, G-MG)

Research Project

16) Employ basic methods of data collection and analysis to compile information for projects. Use available research methods when project planning and problem solving. Synthesize research to present appropriate precedents for development of a project and articulate logical rational for the use of chosen precedents. Create a detailed presentation or written report, citing evidence from research. Examples include a proposal for how a specific plot of land should be developed to meet the needs of a given neighborhood; or a proposal for a new product based on consumer market data for a target audience. (TN Reading 1, 2, 4, 6, 9; TN Writing 1, 4, 8, 9)

Design Project

17) Use the design process to create schematic designs employing discipline-appropriate representational media (such as sketches, technical drawings, and preliminary models) for a given problem set. Prepare and present schematic designs to peers and others, citing research to justify design solutions. Note constructive feedback received and use it to refine the design. (TN Reading 1, 2, 3, 4, 7, 8, 9; TN Writing 1, 4, 5, 9; TN Math N-Q, G-GMD, G-MG)

18) Drawing on results from the schematic design phase, create discipline-appropriate drawings based on industry standards, a three-dimensional model of the design, and presentation boards. Present final design conclusions to members of the profession as well as peers; justify design decisions as would an architect or engineer delivering a pitch to a prospective client. (TN Reading 2, 3, 4, 9; TN Writing 1, 4, 5, 9; TN Math N-Q, G-GMD, G-MG)

19) Compile working drawings in a comprehensive set, including a bill of materials with allowable material alternatives. Demonstrate the ability to properly select the drawing scale, select the views, lay out drawings, and organize the drawing set according to industry standards. (TN Reading 2, 3, 4; TN Math N-Q, G-GMD, G-MG)

Project Management

20) Examine how architects and engineers conduct project management processes, including but not limited to setting interim goals, tracking progress, and coordinating with construction professionals and clients. Compare and contrast components of project management models gathered from textbooks, online resources, and actual case studies of major or local design professionals. (TN Reading 7, 9; TN Writing 4, 8)

21) Utilize project management strategies to create and implement a work plan to complete projects according to schedule. Use technology to periodically document project status and progress in written reports. (TN Reading 3, 4; TN Writing 2, 4, 6)

22) Create a written report or infographic describing the basic steps of traditional project delivery, outlining who and what is involved in each step. Compare texts to describe alternatives to traditional project delivery methods, such as the design-build method used in construction. (TN Reading 1, 2, 4, 5, 7; TN Writing 2)

Portfolio

23) Update the portfolio to reflect the cumulative total of all projects undertaken across the program of study. Continually reflect on coursework experiences and revise and refine the career plan generated in the introductory course. Include written descriptions of drawing types and learning outcomes. (TN Writing 4, 5, 7, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.

- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Foundations of Interior Design

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6014
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the first course in the *Interior Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Foundations of Interior Design is the first course in the *Interior Design* program of study intended to prepare students for careers in residential and commercial interior design. Standards in this course include career exploration of various options within the interior design industry as well as an overview of the history of architecture and design. Projects will involve individual and team assignments. Upon completion of this course, proficient students will be able to analyze and demonstrate the elements and

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the principles of design, and apply these concepts using sketching techniques in the creation of perspective floor plans. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This is the foundational course in the *Interior Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with interior design applications, such as the use of adhesives, hand tools, machines, and appropriate handling and storage methods in accordance with local, state, and federal safety and environmental regulations.
   a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
   b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
   ~~(TN Reading 3, 4; TN Writing 4; FACS 11)~~

History of Architecture and Interior Design

2) Synthesize research from textbooks, interior design magazines, and professional journals to create an annotated timeline or visual graphic illustrating significant time periods in the development of architecture from the beginning of civilization to the present. ~~(TN Reading 3, 7; TN Writing 2, 9; FACS 11)~~

3) Research and summarize in a clear and coherent informational artifact (e.g., a brochure, poster, fact sheet, narrative, or presentation) the influences of major interior designers or architects and their contributions to the design industry. Include the designers' names, major contributions, and examples of their works. ~~(TN Reading 2, 9; TN Writing 2, 4, 7, 9; FACS 11)~~

4) Identify and compare distinguishing features of furniture styles from the medieval period to the present. Classify historic period in a graphic format based on the construction features, design elements, materials and functions. ~~(TN Reading 2, 4, 7)~~

Trends in Design

5) Research trends in interior design using trade journals, design magazines and internet sources. Create an annotated display that visually illustrates current trends in flooring, window

treatments, appliances, kitchen and bathroom design, colors and lighting. (TN Reading 1, 5, 9; TN Writing 7, 8, 9)

6) Research the principles of green design and responsible design and sustainable design. Evaluate the cost, benefits and challenges posed by using green design. Create a chart comparing traditional products to environmentally responsible products. (TN Reading 7, 8, 9; TN Writing 7, 9; FACS 11)

Career Investigation

7) Identify and analyze career pathways within the Interior Design program of study. Cite supporting evidence from textbooks, interior design magazines, and professional journals to summarize the essential knowledge and skills required for these careers. Complete one or more career aptitude surveys and analyze the results. Compose an essay, describing the relationships between personal career aptitudes and careers in interior design. Careers may include, but are not limited to, the following:
   a. Interior Designers
   b. Textiles Designers
   c. Industrial Designers
   (TN Reading 1, 2, 3, 7, 9; TN Writing 2, 4, 8, 9; FACS 1, 11)

8) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to investigate local and regional occupational opportunities and trends in the interior design industry. Synthesize collected data to develop a graphic illustration comparing occupations by education requirements, job availability, salaries, and benefits. (TN Reading 2, 7, 9; TN Writing 4, 8, 9; FACS 1, 11)

Principles and Elements of Design

9) Analyze the elements of design in the context of interior design by evaluating their effect and application in interiors, furnishings, and accessories.
   Elements:
   a. Line
   b. Shape/Form
   c. Space /Size/Stability
   d. Value
   e. Color
   f. Texture
   (TN Reading 3; FACS 11)

10) Illustrate the principles of design by creating an informational artifact that represents the selection and arrangements of interiors, furnishings, and accessories using those principles.
   Principles:
   a. Unity
   b. Harmony
   c. Balance
   d. Rhythm/Repetition
   e. Contrast/ Variety

f. Dominance/Emphasis
g. Gradation
(TN Reading 3; FACS 11)

11) Drawing on the application of color theory in interior design, analyze the color wheel to identify techniques that achieve desired hues, values, intensities and color schemes. Demonstrate the ability to coordinate colors to create unity in furnishings, backgrounds, and accessory samples in various color schemes. (TN Reading 3; FACS 11)

12) Research the psychological characteristics of colors, comparing and contrasting the differences in warm and cool color palettes. Illustrate and describe in a written narrative how color is measured in hue, value, and intensity, and how these properties combine to produce specific psychological characteristics. Produce examples that demonstrate how and why color hues may be used in certain areas of a floor plan. (TN Writing 2, 4; FACS 11)

Traffic Patterns & Floor Plans

13) Examine the guidelines for space planning and traffic patterns in residential structures. Create a list of typical rooms in a residence, describing the desired characteristics and space requirements for each. (TN Writing 4, 8; FACS 11)

14) Assemble a design of a room using hand sketch techniques to create a floor plan, including outlining space planning guidelines and traffic patterns. Write a narrative describing the room's design concept, highlighting where the principles and elements of design and color theory have been applied. (TN Writing 2, 4; FACS 11)

15) Analyze examples of dimensional floor plans and architectural blueprint symbols and explain how interior designers use them throughout the design process. Demonstrate the ability to consult and interpret blueprints in order to aid in the drafting of hand sketches of floor plans. Compile the sketches completed in the course with other artifacts for inclusion in a design portfolio to be updated throughout the program of study. (TN Reading 3, 4, 7; FACS 11)

Interior Design Portfolio

16) Gather examples of professional portfolios from contemporary interior designers, retrieved from designers' webpages, CVs, or postsecondary design schools. List the items that are often included in an interior design portfolio. Write a short paper describing the benefits of keeping a professional portfolio. (TN Reading 1, 4; TN Writing 2, 4; FACS 11)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).

- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Residential Interior Design

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6006
Prerequisite(s):	*Foundations of Interior Design* (6014)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the second course in the *Interior Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Residential Interior Design is the second course in the *Interior Design* program of study intended to prepare students for careers in residential and commercial interior design. Students will engage in the development of board presentation techniques for residential spaces using textiles samples and three-dimensional sketches. Upon completion of this course, proficient students will be able to use manual drafting tools and computer-aided drafting software to create original floor plans, perspective drawings,

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and color renderings. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This is the second course in the *Interior Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with interior design applications, such as the use of adhesives, hand tools, machines, and appropriate handling and storage methods in accordance with local, state, and federal safety and environmental regulations.
   a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
   b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
   ~~(TN Reading 3, 4; TN Writing 4; FACS 11)~~

Design Software

2) Consult software manuals and user guides to become familiar with the use of various design software and computer-aided drafting (CAD) programs. Demonstrate basic operations such as:
   a. Open a new file or existing file; save a file.
   b. Navigate the various menu bars.
   c. Use basic commands to create a two-dimensional computer generated floor plans.
   d. Use basic commands to create a three-dimensional computer generated renderings.
   ~~(TN Reading 1, 3, 4; FACS 11)~~

Residential Floor Plans

3) Demonstrate proficiency in basic concepts of scale drawings by creating simple two-dimensional drawings with the use of manual drafting tools and computer-aided drafting software. Create a floor plan for a selected room, indicating furniture, built-ins, and architectural features measured and drawn to scale.
   a. Develop two-dimensional drawings by using proper sketching techniques and measurement systems (i.e., including fractions, decimals, United States customary units, and metric units).
   b. Create and assemble a three-dimensional model for a residential living space, demonstrating effective use space planning.

     c. Produce a clear and coherent written analysis of the model in terms of the room's design and space concept. Assess how the purpose of the space shapes the content and functionality of the room design.
(TN Writing 4; FACS 11)

4) Demonstrate quick-sketching techniques to design rooms, and then create the computer-aided drawings using design presentation software such as Photoshop, SketchUp, Revit, or AutoCAD. (TN Reading 1, 3, 4; FAC 11)

5) Using an instructor-approved software program, draw basic three-dimensional scale drawings to create renderings of a range of residential rooms (living room, adult and child bedrooms, kitchen and utility, bath, home office, etc.) that illustrate the principles of interior design. Write a short narrative to accompany each drawing to highlight the design principles illustrated in each. (TN Reading 1, 3, 4; TN Writing 4; FACS 11)

Interior Environment

6) Gather relevant information from textbooks and interior design magazines on the various components of the interior environment, assessing the credibility and accuracy of the sources in illustrating the principles of interior design. Integrate the information retrieved to guide the development of a three-dimensional drawing or model, then create a presentation for a prospective client outlining of the appropriateness of selected components, including but not limited to the following:
     a. Types of flooring
     b. Lighting
     c. Wall and surface finishes
     d. Accessories
(TN Reading 1, 7, 8)

7) Research architectural structural elements to describe the options, features, and possible design applications of the following:
     a. Windows
     b. Doors
     c. Cabinetry
     d. Fixtures
     e. Other relevant features
Create a brochure, digital presentation, or display showcasing the findings.

8) Compare and contrast different types of window treatments, such as curtains or drapes, blinds, shades, cornices, swags, and valances, and determine the appropriate window treatment based on window type and customer requirements. Write an analysis of how the choice for a given window treatment impacts privacy, light control, and energy efficiency against practical considerations such as feasibility of installment, cost, and weather conditions specific to particular climate. (TN Reading 1, 7; TN Writing 2, 4, 9)

9) Interpret manufacturing specifications when establishing guidelines for selecting furniture, taking into account needs, styles, budget, durability, safety, and environmental impact. Evaluate

claims made by manufacturers and customer reviews in order to analyze furniture selections in terms of their suitability for clients in design scenarios.

Project Management

10) Create an outline that illustrates the basic components of project budgets commonly used in interior design proposals (e.g., itemized budgets, non-itemized budgets, fixed budgets, and flexible budgets). Implement outline components to generate a comprehensive budget including walls and floors, lighting, focal furniture pieces, and labor costs for a residential living space. ~~(TN Reading 3; TN Writing 4)~~

11) Examine how businesses in the interior design industry conduct project management processes in residential settings. Compare and contrast components of project management models gathered from case studies of major or local designers. Generate a project management template that addresses the objectives required for designing a residential living space. ~~(TN Reading 7, 9; TN Writing 4, 8)~~

Textiles

12) Research and create a chart of natural and manmade fibers, and the textiles made from them, as they are used in residential applications such as draperies, carpets, and upholstery. Describe in the chart the principle characteristics, best applications for the fibers/textiles, care guidelines, and any associated environmental or safety concerns. Expand the chart to prepare a more detailed guide including samples to be used in presentations to clients. ~~(TN Reading 1, 4, 7; TN Writing 2, 4, 7)~~

13) Research the Textile Fiber Products Identification Act that defines and regulates the labeling of textile products, Flammable Fabrics Act, Care Labeling Rule and the Wool Products Labeling Act that specifies regulations about the labeling of products containing wool. Evaluate the necessity of such laws and d. Summarize the key points of each of the acts in a chart, table, or short narrative. ~~(TN Reading 1; TN Writing 2, 4)~~

Presentation Boards

14) Research how interior design companies create presentation boards. Citing examples, identify characteristics of effective presentation boards. Drawing on the research, compile a list of materials required for a presentation board showcasing one room in a residential setting.

15) Assemble a presentation board that incorporates a collage of color samples, fabric, and flooring, mounted with the color elevation rendering that orderly and logically presents a particular theme in color or style of design. . Evaluate these elements visually and tactually to determine the most effective combination that will meet the needs of the client. ~~(TN Reading 4; FACS 11)~~

16) Produce a clear and coherent verbal defense of the presentation board as well as a written narrative that explains the principles of design, justifies the choice of samples, and includes a complete cost analysis of the project. Capture the presentation on video or other media along

with photographs to include in the design portfolio with the written paper. ~~(TN Writing 2, 4)~~

Interior Design Portfolio

17) Update materials, photographs, and sketches from coursework to add to the portfolio begun in the foundations course. Include descriptions of the creative thought process behind each project included. ~~(TN Writing 2, 4)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 2, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6 and 10 at the conclusion of the course.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Commercial Interior Design

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6122
Prerequisite(s):	*Residential Interior Design* (6006)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the third course in the *Interior Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Commercial Interior Design is the third course in the *Interior Design* program of study intended to prepare students for careers in residential and commercial interior design. Important components in this course include developing an understanding of specifications for commercial design, building technology, building codes, product applications, and product testing research and development. Students will work individually and in teams to make presentations to prospective commercial clients

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and defend their designs and presentation boards. Upon completion of this course, proficient students will be able to create three-dimensional pictorial representations of objects by way of size, shape, shading, and color using industry-standard software programs. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee state standards for Scientific Research, and National Standards for Family and Consumer Sciences Education, Second Edition.*

Program of Study Application

This is the third course in the *Interior Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with interior design applications, such as the use of adhesives, hand tools, machines, and appropriate handling and storage methods in accordance with local, state, and federal safety and environmental regulations.
   a. Inspect, maintain, and employ safe operating procedures with tools.
   b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
   (TN Reading 3, 4; TN Writing 4; FACS 11)

Design Software

2) Use computer-aided software tools to design floor plans or create perspective drawings using appropriate symbols, abbreviations, and call outs to indicate placement of windows, doors, electrical outlets, plumbing, and other structures. (TN Reading 4; FACS 11)

3) Apply textures, color, and finishes to elevations and perspective drawings. Use layers and overlays to demonstrate alternate designs of the same structures. (TN Reading 1, 3, 4; FACS 11)

Commercial Design

4) Research and compare the fields of residential interior design to commercial interior design. Integrate the information into a research project including a written report and class presentation, demonstrating an understanding of the differences and similarities among residential and commercial interior design careers. (TN Reading 3, 4; TN Writing 2, 4, 6, 9; FACS 11)

5) Review and evaluate design interiors of commercial spaces presented in diverse formats such as design books and building magazines. After review, create and continuously log sketches and

gather sample pictures of appealing furniture layout, window treatments, accessories, and floorings for inclusion in future design projects. Compile sketches and sample pictures into a personal design book along with a brief paragraph to accompany each sketch, describing what aspects of the design are appealing and why. (TN Reading 7; TN Writing 10; FACS 11)

6) Research the various material used in the exterior rendering. Design a commercial building rendering by sketching the exterior with a three-dimensional design program. Then sketch the exterior facade, attending to appropriate representations for metal, wood, brick, glass, or any combination of exterior materials. Compile the sketches and other artifacts for inclusion in the design portfolio, along with a written defense of the material choices, citing evidence of the material's durability, practicality, cost effectiveness, and sustainability.. (TN Reading 1, 3, 4; FACS 11)

7) Research the placement of furniture and arrangement of interiors for commercial spaces. Generate floor plans that incorporate effective commercial space planning techniques. Write a short narrative to accompany the drawings, highlighting the design principles illustrated in each. (TN Writing 4; FACS 11)

8) Research space requirements, traffic flow, and design features necessary for a commercial space. Create a rendering and assemble a three-dimensional interior design for the space, demonstrating effective use of principles and elements of design learned in previous courses. The design should be specific to a particular venue, such as but not limited to:
   a. Hospitality venues (i.e., restaurants, hotels, event spaces)
   b. Offices
   c. Spas or fitness centers
   d. Retail space
   (TN Reading 1, 3, 4; FACS 11)

9) Research field verifications in the context of client project analysis and produce a synthesis of how interior designers incorporate field verification data to best meet the client needs. Prepare a written plan or proposal for conducting field verification analysis for the commercial venue selected in standard 7, including a proposed timeline with key deliverables to present to a mock client. (TN Reading 4; TN Writing 2, 4, 9; FACS 11)

10) Conduct an original field verification analysis to determine materials, layout, space distribution, and interior walls arrangement needed for the commercial venue project in standard 7. (TN Reading 3; FACS 11)

Policies and Regulations

11) Research relevant legislation, regulations, zoning laws, and building codes regulating environmental, health, and safety requirements for specific commercial facilities. Create a series of informative or explanatory texts that clearly and accurately convey the minimum compliance requirements and benchmarks needed to achieve an energy-efficient building designation. (TN Reading 1, 4, 10; TN Writing 2, 4, 9; FACS 11)

12) Research how Universal/Barrier Free design principles impact commercial design. Identify modifications that are necessary to furnishings, floor plans, materials, and fixtures to

accommodate the needs of people of all ages and physical abilities in compliance with the Americans with Disabilities Act (ADA). Analyze photos of commercial spaces to determine the universal/barrier free design principles that were used and write narrative about their usefulness for the elderly, children, or people with physical limitations. (TN Reading 9; TN Writing 2, 9)

Textiles

13) Research and create a chart of natural and manmade fibers, and the textiles made from them, as they are used in commercial applications such as draperies, carpets, and upholstery. Describe in the chart the principle characteristics, best applications for the fibers/textiles, care guidelines, and any associated environmental or safety concerns. Expand the chart to prepare a more detailed guide including samples to be used in presentations to clients. (TN Reading 1, 4, 7; TN Writing 2, 4, 7; FACS 11)

14) Research *ASTM D4850 -13* for standard terminology relating to fabrics and fabric test methods. Limit the search to textiles used in interior furnishings. Create a chart summarizing the broad classifications of tests performed on textiles, the standards organizations that have developed methods for testing each characteristic, and any additional information that describes the test method, application, reliability, and interpretation of the results. (TN Reading 1, 2, 4; TN Writing 2, 4, 9; FACS 11)

15) Differentiate between the Wyzenbeek and Martindale Abrasion Tests. Evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence supporting the abrasion rating. Develop guidelines for choosing fabrics for specific residential or commercial applications that indicates the number of double rubs (Wyzenbeek) or cycles (Martindale) a fabric should withstand. (TN Reading 4; TN Writing 2, 4, 9; FACS 11)

16) In small groups, follow the scientific method to develop protocol to test for some characteristic of fabric, upholstery, or carpet materials, such as fade resistance, durability, or shrink resistance. Follow the protocol and laboratory test fabric samples. (TN Writing 2, 4, 7; TN Scientific Research Standards 1, 2, 3, 4, 5; FACS 11)

Project Management

17) Create an outline that illustrates the basic components of project budgets commonly used in commercial interior design proposals (e.g., itemized budgets, non-itemized budgets, fixed budgets, and flexible budgets). Implement outline components to generate a comprehensive budget including walls and floors, lighting, focal furniture pieces, and labor costs for a commercial office space. (TN Reading 3; TN Writing 4; FACS 11)

18) Examine how commercial designers conduct project management processes including but not limited to adhering to local building codes, obtaining building permits, and coordinating with construction professionals and clients. Compare and contrast components of project management models gathered from case studies of major or local commercial designers. Generate a project management template that addresses the objectives required for designing a commercial office space. (TN Reading 7, 9; TN Writing 4, 8; FACS 11)

Presentation Boards

19) Compile a list of materials required for a presentation board featuring a commercial setting. Incorporate a wide range of material samples. Evaluate these elements visually and tactually to determine the most effective combination that will meet the needs of the client. (TN Reading 4; FACS 11)

20) Analyze the material samples to select those suitable for a specific type of commercial design setting. Create the presentation board in a collage of color samples, fabric, and flooring, mounted with the color elevation rendering that orderly and logically presents a particular theme in color or style of design (FACS 11).

21) Produce a clear and coherent verbal defense of the presentation board as well as a written narrative that explains the principles of design, justifies the choice of samples, and includes a complete cost analysis of the project. Capture the presentation on video or other media along with photographs to include in the design portfolio with the written paper. (TN Writing 1, 4; FACS 11)

Interior Design Portfolio

22) Update materials, photographs, and sketches from course work to add to the portfolio begun in the foundations course. Include descriptions of the creative thought process behind each project included. (TN Writing 2, 4; FACS 11)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 5 at the conclusion of the course.
- TN Scientific Research Standards 1, 2, 3, 4, and 5 may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advanced Interior Design

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6121
Prerequisite(s):	*Commercial Interior Design* (6122)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Interior Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-architecture-construction

Course Description

Advanced Interior Design is an applied-knowledge course intended to prepare students for careers in the interior design industry. This course places special emphasis on an internship opportunity and a hands-on capstone project. Upon completion of this course, proficient students will create a design for a specific space and purpose, either residential or commercial, applying skills and knowledge from

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previous courses and industry-specific technologies. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Work-Based Learning Framework

Optional internship** standards outlined below may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth and final course in the *Interior Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at https://tn.gov/education/article/cte-cluster-architecture-construction.

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with interior design applications, such as the use of adhesives, hand tools, machines, and appropriate handling and storage methods in accordance with local, state, and federal safety and environmental regulations.
    a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
    b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
    c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
    ~~(TN Reading 3, 4; TN Writing 4)~~

Professional Practices of Interior Design

2) Research job descriptions, career information, and online job boards such as the IIDA Career Center for the general employability skills and character traits most often mentioned or desired for interior design professionals. Compile a class list of those skills and attributes. For each item on the class list, define the characteristic, state why it is important for people working in the interior design field, and list at least two ways to build that skill. Possible skills include:
    a. Collaboration
    b. Honesty

     c. Respect

     d. Communication

     e. Responsibility

     (TN Reading 1, 4; TN Writing 2, 4, 8; FACS 1, 11)

3) Collect Codes of Ethics from various interior design professional organizations such as the American Society of Interior Designers (ASID) and the International Interior Design Association (IIDA), and compare them for areas of commonality. Discuss the significance of incorporating ethical standards into professional practice. Synthesize principles from the codes investigated to create a personal code of ethics for use as a designer; include the code in the design portfolio. (TN Reading 1, 2, 4, 9; TN Writing 4, 8, 9; FACS 11)

4) Access electronic resources, including the websites of professional organizations, to identify voluntary and required credentials and licensing requirements for interior designers. Create a brochure that lists the credentials available and the requirements for obtaining and maintaining the credential. Determine the licensing requirements to become a certified interior designer. (TN Reading 1, 4; TN Writing 2, 4, 7, 8; FACS 1, 11)

Resource Management

5) Perform an Internet search, interview local professionals, or consult industry journals to identify common principles of successful project management. Drawing on the project management templates developed in previous courses, estimate a detailed project plan for a potential interior design project. The project plan should include at minimum the following: a schedule or Gantt chart outlining deliverables; a tracker for progress toward goals; a time management component to log hours worked for those involved; a spreadsheet for analyzing cost and performance; and a document to coordinate tradesmen and other labor. (TN Reading 1, 4, 7, 10; TN Writing 4, 6, 7; FACS 11)

6) Research interior design budget sources from company websites or textbooks to create a list of the components of a project budget. Estimate a budget for a potential project in a spreadsheet program. Each budget should include at minimum columns for estimated costs, actual costs, and difference. (TN Reading 4, 7, 9; TN Writing 6; FACS 11)

7) Create a name for an original interior design company. Design a logo for the company. Apply concepts and templates from word processing programs to create one or more of the following business necessities: business stationery, invoices, sample rates, specific project cost estimates, and business cards. (TN Reading 1, 4; TN Writing 2, 4, 8; FACS 11)

8) Research different types of businesses structures, including but not limited to sole proprietorship, partnership, s-corporation, and limited liability company. Write a business plan explaining the type of business, organizational design, the steps in establishing the business, and the legal parameters affecting the business. Identify the target market; describe in the plan how the particular suite of design services offered by the proposed company will be marketed to the intended consumers. (TN Reading 1, 4; TN Writing 2, 4, 8; FACS 11)

Communication

9) Practice effective verbal, nonverbal, written, and electronic communication skills for working with clients while demonstrating the ability to: listen attentively, speak courteously and respectfully, discuss client's ideas/vision, resolve obstacles in design, and respond to client objections or complaints to the client's satisfaction. (TN Writing 4, 6; FACS 11)

10) Select two distinctly different designs for an interior design project and present them to a client, supported by graphic renderings and written appraisals of the work. Justify why each would be appropriate given the client's specifications, while also noting the drawbacks and compromises to each one based on client needs. (TN Writing 1, 4; FACS 11)

11) Presented with two alternative designs for a given project, highlight the design features of each. Make a written case for selecting one design over another, or for integrating features from each to come up with a design that will suit the venue and satisfy the client. Demonstrate the ability to pitch the idea to the client in a mock bid, defending the design by pointing to specific features that meet the client's specifications. (TN Writing 1, 4; FACS 11)

Obstacles in Design

12) Define design obstacles and prepare a list of potential obstacles encountered in residential or commercial venues, such as environmental concerns, budget constraints, or marketability. Use research from design magazines and technical manuals to suggest design solutions that effectively deal with these obstacles. (TN Reading 7; TN Writing 2, 4; FACS 11)

13) Create a proposed design narrative and presentation board to share with a client. Integrate multiple sources of information, such as original field verification analyses, to make informed design decisions, solve design obstacles, and present the findings in a clear and coherent manner as a verbal or written report. (TN Reading 7; TN Writing 2, 4; FACS 11)

Internship (Optional)**

14) If available, participation in an interior design internship is encouraged. Internship placements are approved at the discretion of the instructor, based on local availability and the instructor's own assessment of the internship's quality.

15) Maintain a professional image by applying the employability skills and attitudes explored in Standard 2. Keep a journal/log of the assignments completed on the job. Near the end of the internship, work with the intern supervisor to discuss strengths and weaknesses. (TN Writing 4, 6)

16) Upon conclusion of the internship, produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation will be included in the student's portfolio. (TN Writing 4, 6)

Capstone Project

17) Create a comprehensive design for a specific space and purpose, either residential or commercial, applying skills and knowledge from previous courses. Students should be able to visit the site to make measurements and complete field verification. Create a client presentation to include:
   a. A project plan
   b. Statement of how the design meets applicable codes and regulations
   c. Presentation board(s) and 3-D models of the project
   d. Drawings that incorporate principles and elements of design correctly
   e. Select appropriate finishing and materials
   f. A comprehensive cost estimate based on researched prices
   (TN Reading 3, 7; TN Writing 2, 7, 4)

Portfolio

18) Create a career and professional growth plan outlining the steps needed to progress in a specific career pathway, including postsecondary education, potential paid and unpaid jobs that will build experience, and additional opportunities for development. Include the plan in the student portfolio. (TN Writing 2, 3, 4)

19) Research formats and styles of resumes commonly used by interior design professionals. Use templates or online resume builders to create a personal resume. Write a short narrative describing why the current format was chosen, presenting a plan for keeping the resume up-to-date, and describing how it can be tailored for specific situations. Include the resume in the student portfolio. (TN Reading 5; TN Writing 2, 4)

20) Update the portfolio to reflect the cumulative total of all portfolio projects undertaken across the program of study. Compile information, sketches, and photographs from each course project work. Include floor plans, drawings, and materials used. Include technical drawings that demonstrate ability to use industry-specific technology such as such as Photoshop, SketchUp, Revit, or AutoCAD. Select projects from course work that showcase qualifications as an interior design student.

   Upon completion of this course, the following artifacts will reside in the student portfolio:
   o Resume
   o Career and professional growth plan
   o Personal code of ethics
   o Communication exercises
   o Example sketches showing best work from any course
   o Residential interior design project board
   o Commercial interior design project board
   o Capstone project
   (TN Reading 1, 4, 7; TN Writing 2, 4)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 8 and 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Digital Arts & Design I

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6084
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the first course in the *Digital Arts & Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	153, 230, 311, 435, 436, 475, 476, 516, 519, 520, 521, 537, 538, 543, 576, 583, 597, 710, 711
Required Teacher Certifications/Training:	ADDA Certified Digital Designer or NOCTI Advertising & Design or Adobe Certified Expert
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

Digital Arts & Design I is a foundational course in the Arts, A/V Technology, & Communications cluster for students interested in art and design professions. The primary aim of this course is to build a strong understanding of the principles and elements of design and the design process. Upon completion of this course, proficient students will be able to utilize industry tools to conceptualize and create

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communications solutions which effectively reach targeted audiences. Students will acquire basic skills in illustration, typography, and photography. Standards in this course include career exploration, an overview of the history of design, basic business management, and legal issues. In addition, students will begin compiling artifacts for inclusion in a digital portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Visual Art standards, and Tennessee Visual Art History standards.*~~

Program of Study Application

This is the first course in the *Digital Arts & Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with art and design applications: the use of adhesives; hand tools; machines; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
    a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
    b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
    c. Complete a safety test with 100 percent accuracy. For equipment used in the course, complete equipment examinations with 100 percent accuracy in which the student performs an operational checkout by the instructor. Maintain a record of safety examinations and equipment examinations.
    ~~(TN Reading 3, 4)~~

Introduction to Design

2) Investigate the role of designers in communicating ideas in society, both historically and currently, emphasizing how social, cultural, economic, and political developments are reflected in and influenced by visual messaging. Synthesize research from informational texts, including design magazines and textbooks, to create an informational artifact that illustrates how visual art and design is used as a communication tool, citing specific examples to illustrate concepts. ~~(TN Reading 1, 2; TN Writing 2, 4, 8, 9; TN Visual Art 1.3, 4.1, 4.2; TN Visual Art History 4.1)~~

3) Research the development of design throughout history, analyzing how advances in technology have impacted design (Gutenberg's invention of movable type, lithography, computers, etc.). Citing resources from informational text, create an annotated timeline or visual graphic emphasizing significant time periods in design (such as Victorian, Arts and Crafts, Modernism, Art Deco, etc.) and the key technological advances impacting design. ~~(TN Reading 1, 2, 4, 7; TN Writing 2, 6, 8, 9; TN Visual Art History 4.1)~~

Career Exploration

4) Identify and analyze the career pathways in art and design professions and the industries in which art and design professionals work, including but not limited to manufacturing, specialized design services, publishing, and advertising. Cite supporting evidence from multiple sources (such as interviews with design professionals retrieved from industry magazines), summarize the aptitudes and training needed for at least three careers of interest. For example, outline the typical requirements needed to become a graphic designer, including personal aptitudes and secondary and postsecondary training required. Devise a tentative career plan to reach employment goals. (TN Reading 1, 2, 9; TN Writing 2, 7)

5) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to explore local and regional occupational opportunities and trends in design careers. Synthesize collected data to develop an informational artifact comparing occupations by job availability, salaries, and benefits. (TN Reading 2; TN Writing 4, 9)

Elements and Principles of Design

6) Categorize and describe the principles of design which affect 1) the internal relationships of a design, and 2) the design as a whole, citing examples of design principles found in art.
   a. Unity
   b. Contrast/Variety
   c. Hierarchy
   d. Dominance/Emphasis
   e. Proportion/Scale
   f. Balance
   g. Rhythm/Repetition
   (TN Reading 1, 2, 4; TN Visual Art 2.1; TN Visual Art History 2.1)

7) Analyze the elements of design by evaluating their purposes and applications in a variety of design applications.
   a. Line
   b. Shape/Form
   c. Space/Size/Stability
   d. Value
   e. Color
   f. Texture
   g. Typography
   For example, label and explain the elements of design in a given book cover compared with a billboard. (TN Reading 4, 7; TN Writing 9; TN Visual Art 2.1; TN Visual Art History 2.1)

8) Research rules of composition (such as the rule of thirds) and explain how the rules govern the elements and principles of design. Write persuasively to describe the properties of a strong composition by providing examples and counterexamples and citing evidence from informational texts. (TN Reading 1, 2, 4, 5; TN Writing 1, 4, 9; TN Visual Art 2.2)

9) Explain the function of the color wheel and identify techniques that achieve desired hues, values, intensities, and color schemes for use in design. Compare and contrast additive and

subtractive color systems, and relate these principles to color specification systems (such as CMYK and RGB) used in design software. ~~(TN Reading 3, 4, 9)~~

10) Research the psychological characteristics of colors, comparing and contrasting the differences in warm and cool color palettes. Illustrate and describe in a written narrative how color is measured in hue, value, and intensity, and how these properties combine to produce specific psychological characteristics and illustrate themes. Produce examples that demonstrate how emotions may be influenced by the use of color in designs. ~~(TN Reading 2, 4; TN Writing 2, 4, 9)~~

11) Examine color theories such as color context and contrasts of colors. Evaluate the use of various color schemes (such as complementary, tertiary, and analogous) in designs. Apply the knowledge to demonstrate basic techniques in combining colors to create designs. ~~(TN Reading 2, 4; TN Visual Art 1.3)~~

12) Analyze, assess, and identify the effectiveness of design products based on the intended function of the design and the principles and elements of design used in the composition. Investigate the intent of a given design and evaluate whether the intent was met through the structure of the design. For example, create an evaluation rubric based on the elements and principles of design and use it to evaluate given design products. ~~(TN Writing 4, 8, 9; TN Visual Art 2.1, 2.2, 2.3, 5.1, 5.2, 5.3)~~

Introduction to the Design Process

13) Research design processes described in textbooks, designers' professional websites, design magazines, or by interviewing design professionals. (Steps may include problem identification, research, identifying the audience, brainstorming, and idea refinement.) Citing research, create a visual illustration describing the major steps to the design process for digital arts and design. ~~(TN Reading 1, 2, 3, 4; TN Writing 4, 7, 8, 9)~~

14) Describe the importance of setting design goals such as determining the purpose, message, and audience for given design projects. Examine the research techniques professionals use to inform design goals and influence design outcomes. For example, describe how designers use market data to identify the audience for advertisement of a given product. ~~(TN Reading 2, 3, 4)~~

Basic Illustration

15) Create two-dimensional and three-dimensional sketches, including rough and refined sketches, demonstrating shape, volume, depth, and dimension. Distinguish among common illustration techniques used in design composition such as one-point, two-point, and multi-point perspective drawings. Develop conceptual design ideas using freehand sketching. For a given design problem, generate, analyze, and refine sketches to develop design solutions. Use the sketches to create refined drawings utilizing design software. For example, create thumbnail sketches to generate ideas for a logo or advertisement. ~~(TN Reading 4, 5, 7)~~

16) Describe how symbols have been used and have been developed throughout history. Explain how symbols communicate visual information in design. Analyze the use of symbols in pictograms, ideograms, and logos, explaining and providing examples of each. ~~(TN Reading 2, 3, 4, 7; TN Writing 9; TN Visual Art 3.1)~~

17) Examine a variety of well-known company logos to create a list of key characteristics that influence a logo's effectiveness. Compare the list with other resources such as textbooks and design journals, evaluating the credibility of each source. Drawing on research, plan and create an effective logo for a given mock company. Appraise the effectiveness of the resulting logo design as well as the designs of peers based on the criteria generated from the prior research. (TN Visual Art 3.1)

Basic Photography

18) Demonstrate basic techniques to adjust camera settings and operate a camera to capture digital images. Define and explain white balance, depth of field, and shutter speed; demonstrate procedures for properly adjusting each for a particular scene. Apply the principles of design and the rules of composition to capture photographs. (TN Reading 2, 3, 4)

19) Read and interpret instructional narratives, such as manuals or tutorials, to perform basic edits and enhancements to photographs using software, including but not limited to cropping, resizing, retouching, making selections, and using layers. Assess the extent to which each text addresses the given editing task. Demonstrate the procedures for editing raster-based imagery, both high resolution and low resolution, in CMYK and RGB, and preparing files for both print and web media. (TN Reading 2, 3, 4, 8)

Introduction to Design Software

20) Demonstrate basic procedures to manage digital files. Describe file storage in memory cards and estimate the number of photographs a memory card can hold based on the resolution of the photographs and other factors. Use a scanner to create digital files. Determine appropriate resolutions for various applications such as printed and web media. Use file system folders to organize files. Utilize online file management services to backup files. (TN Reading 2, 3, 4; TN Writing 6; TN Math N-Q)

21) Distinguish between the various software used for visual design, including page layout software, illustration software, photo editing software, and web publishing software. Describe and illustrate the difference between raster and vector graphics. Create a chart or infographic explaining the major types and uses of design software. Employ the appropriate software to complete assigned tasks. (TN Reading 2, 3, 4; TN Writing 4, 6, 9; TN Math N-Q)

Basic Typography

22) Categorize varieties of type, including but not limited to serif, sans serif, script, and decorative. Employ the units of measurement used to describe line spacing (leading), type size, tracking, and kerning. Apply appropriate typography to given projects, emphasizing readability and the impact on design goals. (TN Reading 2, 3, 4, 7; TN Visual Art 1.3)

Design Projects

23) Apply the design process to complete projects of increasing complexity and of varying applications such as print, web, film, and marketing communications. Demonstrate the ability to select and use the appropriate tools and procedures to accomplish project goals. Prepare an informative narrative to explain a design to a peer, emphasizing how the design process and the design elements and principles were applied. (TN Reading 2, 3, 4, 7; TN Writing 2, 4, 9; TN Visual Art 1.3)

24) Utilize the critique and refinement strategy as part of the design process to achieve project goals. As part of a design project, present preliminary design ideas in a way that is understandable to an audience using both visual and verbal explanations. Note constructive criticism received and use it to influence design refinement. Similarly, evaluate the work of others, drawing on design principles and project goals, to provide clear, specific, and constructive feedback. (TN Reading 2, 3, 4; TN Writing 4, 5, 6, 7, 9; TN Visual Art 1.3, 2.1, 2.2, 5.1, 5.3; TN Visual Art History 2.1)

Ethical & Legal Issues

25) Research and interpret laws and regulations protecting intellectual property as they relate to the design industry, such as copyright laws. Explain ethical and legal conduct that provides proper credit to those whose ideas and content have been used in creating new works. Distinguish between copyrights, trademarks, infringement, and fair use. Summarize and explain guiding principles in a written or oral presentation, as though leading a training or tutorial for fellow employees. (TN Reading 1, 2, 4, 6; TN Writing 2, 4)

Business Management

26) Explore how design professionals and companies calculate profit. Relate the profitability of a business to pricing and cost. For example, create a list of expenses incurred by a freelance designer and calculate the price and amount of work that must be accomplished in order to earn profit. (TN Math N-Q)

27) Describe the components of a basic contract document for design work by analyzing an example contract. Drawing on textbooks, news articles and other resources, explain the benefits of utilizing written contracts as opposed to oral agreements. (TN Reading 2, 3, 4, 6; TN Writing 4, 5, 8, 9)

Portfolio

28) Gather examples of professional portfolios from contemporary designers and photographers. List the items that are often included in a professional portfolio. In a written, visual, or oral presentation, describe the components of a professional portfolio and the benefits of maintaining one. (TN Reading 1, 4; TN Writing 2, 4, 9)

29) Compile important artifacts to create a digital student portfolio that connects personal career preparation to concepts learned in this course, including written descriptions of project processes and reflections on learning outcomes. (TN Writing 4, 5, 6, 9; TN Visual Art 5.1)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Statistics (pages 58-83).
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Visual Art: Tennessee Visual Art: Visual Art standards 1.3, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 5.1, 5.2, and 5.3 may provide additional insight and activities for educators.
- TN Visual Art History: Tennessee Visual Art History: Visual Art History standards 2.1 and 4.1 may provide additional insight and activities for educators.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Digital Arts & Design II

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6086
Prerequisite(s):	*Digital Arts & Design I* (6084)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the second course in the *Digital Arts & Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	153, 230, 311, 435, 436, 475, 476, 516, 519, 520, 521, 537, 538, 543, 576, 583, 597, 710, 711
Required Teacher Certifications/Training:	ADDA Certified Digital Designer or NOCTI Advertising & Design or Adobe Certified Expert
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

Digital Arts & Design II is a course that builds on the basic principles and design process learned in the introductory *Digital Arts & Design I* course. Upon completion of this course, proficient students will be able to perform advanced software operations to create photographs and illustrations of increasing complexity. Students will employ design principles and use industry software to create layouts for a

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variety of applications. Standards in this course also include an overview of art and design industries, career exploration, and business management. In addition, students will continue compiling artifacts for inclusion in a digital portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Visual Art standards, and Tennessee Visual Art History standards.*~~

Program of Study Application

This is the second course in the *Digital Arts & Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with art and design applications: the use of adhesives; hand tools; machines; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
   a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
   b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   c. Complete a safety test with 100 percent accuracy. For equipment used in the course, complete equipment examinations with 100 percent accuracy in which the student performs an operational checkout by the instructor. Maintain a record of safety examinations and equipment examinations. ~~(TN Reading 3, 4)~~

The Art & Design Industry

2) Analyze how art and design professionals interact with other professionals within industry. Perform a case study of a company to evaluate the role of art and design professionals within the company. Create an oral, written, or visual presentation of findings. For example, investigate a package designer's interactions with engineers, managers, and assembly crews in a manufacturing company to create package designs for a product. ~~(TN Reading 1, 2, 5; TN Writing 2, 9)~~

3) Develop a research paper, media production, or visual display demonstrating the impact of technology and industry trends on the careers of art and design professionals, including the impact on technical work and business management. Write persuasively to describe the personal traits and skills needed for professionals in the field as technology advances and industry trends change, citing an example of an emerging or future technology or trend. ~~(TN Reading 2, 8; TN Writing 1, 4, 6, 8, 9)~~

Career Exploration

4) Research postsecondary institutions (i.e., colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer art and design programs. Summarize admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare individuals to be successful in an art or design program. Evaluate the tentative career plan developed in the introductory course in light of these findings, and update the career plan to reflect any new discoveries, citing evidence from the research. (TN Reading 1, 2; TN Writing 4, 7, 9)

Principles of Photography

5) Analyze the relationship between shutter speeds, f-stop, and ISO settings in determining the exposure of an image. Synthesize information from instructional manuals and other resources to appropriately adjust manual camera settings including shutter, ISO, f-stop controls, and white balance to take photographs for a range of settings and content. (TN Reading 1, 3, 4, 5)

6) Identify and differentiate between different lighting techniques, such as strobe lighting, bounce flash, and diffusing devices, describing the purposes and functions of each. Appraise a given setting and content and draw a conclusion about the appropriate lighting techniques to take a quality photograph. Defend choices by citing data and evidence to support claims and address counterclaim(s). (TN Reading 1, 4; TN Writing 1)

7) Develop photo editing skills by utilizing software operations of advancing complexity to modify and enhance images. For example, use layers to manipulate parts of an image independently or remove objects from an image. Explain the steps required to perform a given photo editing technique in a presentation such as an instructional video or text with supporting graphics. (TN Reading 1, 2, 3; TN Writing 2, 4, 9)

8) Document photography activity in a photography journal or portfolio. Use proper measurements and terminology to record camera settings and lighting techniques when capturing photographs in a variety of environments. Include any editing techniques performed using software and the resulting photographs. Reflecting on the results, summarize strategies for taking photographs in at least three different environments in a written narrative, citing evidence from supporting texts as well as the finished product. (TN Reading 1, 2; TN Writing 4, 6, 9)

Principles of Illustration

9) Create and modify vector illustrations of increasing complexity. Apply the principles of design and utilize advanced software tools such as live trace, creating gradients, transforming objects, and more. (TN Reading 3, 4; TN Visual Art 2.1; TN Visual Art History 2.1)

Visual Layouts

10) Use publishing software to create single- and multi-page layouts. Apply and build on compositional techniques learned in the introductory course, including the rule of thirds. Describe the elements of a page layout, including headings, body text, illustrations, frames,

color schemes, and white space. Identify and use layout tools such as a grid system, guides, margins, columns, gutters, and rows. Distinguish among measurement and layout terminology such as picas, bleeds, and slugs. Based on a project's theme and the medium of the final product, create comprehensive layouts properly integrating page layout elements, design principles, and compositional techniques. (TN Reading 3, 5; TN Writing 6, 9; TN Math N-Q, G-MG; TN Visual Art 2.1; TN Visual Art History 2.1)

11) Apply mathematics concepts and measurement techniques to design and finish layouts. Concepts should include, but are not limited to:
    a. Determining and applying the equivalence between fractions and decimals. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch.
    b. Working with units such as feet, inches, meters, centimeters, millimeters, and picas. For example, convert a dimension from centimeters to inches.
    c. Performing proportionate reasoning to estimate quantities, such as determining the appropriate scale of an image for a given sheet size.
    (TN Reading 3; TN Math N-Q, G-MG)

12) Apply principles of typography as they relate to layout and page composition in order to appropriately use various forms of type when designing layouts. Employ typography tools to manipulate text within layouts such as threading and flowing text frames. Further, investigate the use of typography as an expressive form. For example, use text as an image or combine type and image into a cohesive form. (TN Reading 3, 4; TN Writing 6)

13) In teams, use software to create complex layouts, including multiple-page layouts, large displays, and/or product designs (i.e., for corporate branding packages, product-line packaging and marketing, and more). Demonstrate consistency of style throughout the design package while managing the storage of complex files within the selected software environment. (TN Reading 3; TN Writing 4, 6)

14) Understand the connection between digital layouts and final products, such as understanding the difference between the screen color and the print color. Prepare layouts for production by testing and refining files using pre-flight procedures. Make final products in varying formats, including but not limited to layouts printed on paper and layouts published digitally. (TN Reading 3, 4; TN Writing 6)

Projects

15) Employ research methods when planning a design project, including data collection and analysis. Synthesize research to present appropriate precedents for the development of a project and articulate logical rationale for the use of chosen precedents. Create a detailed presentation or written report, citing evidence from research, which summarizes design decisions in light of research findings. For example, conduct a survey to determine the target audience for a given company branding package, and select colors and symbols based on the target audience. (TN Reading 1, 2, 6, 9; TN Writing 2, 4, 6, 9)

16) Apply the design process to complete projects of increasing complexity and of varying applications such as print, web, film, and marketing communications. Demonstrate the ability to

select and use the appropriate tools and procedures to accomplish project goals. Prepare a persuasive narrative to explain the design to a client, communicating the project in such a way that is understandable to the audience. (TN Reading 7; TN Writing 1, 4; TN Math N-Q, G-MG)

17) Utilize the critique and refinement strategy as part of the design process to achieve project goals. As part of a design project, present preliminary design ideas in a way that is understandable to an audience using both visual and verbal explanations. Note constructive criticism received and use it to influence design refinement. Similarly, evaluate the work of others, drawing on design principles and project goals, to provide clear, specific, and constructive feedback. (TN Writing 4, 5, 6, 7, 9; TN Visual Art 1.3, 2.1, 2.2, 5.1, 5.3; TN Visual Art History 2.1)

18) Complete a design project in a specific application (i.e., print, web, film, marketing, or other design communications) using multiple software formats. Referencing supporting evidence such as industry standards, select the appropriate software for each specific task and efficiently manage file content. Convert and export files as needed for the given application. For example, place photographs and illustrations in publishing software by appropriately linking the files. (TN Reading 3, 5)

19) Explore time management techniques utilized by professionals from case studies or professional organizations, noting key habits and best practices of freelance designers as compared with their salaried peers. Create and implement a work schedule, timeline, and budget for completing a given project. (TN Reading 9; TN Writing 2, 4, 7, 9)

Business Management

20) Analyze the relationship and responsibilities of various parties involved in a business contract. Write a basic contract for design work, such as a graphic designer's contract with a new business to create a marketing package. Emulate a design professional by explaining the contract to a mock client. (TN Writing 2, 4)

Portfolio

21) Update materials from coursework to add to the digital portfolio begun in *Digital Arts & Design I*, including artifacts that demonstrate ability to use industry-specific technology. Continually reflect on coursework experiences and revise and refine the career plan generated in the introductory course. Include written descriptions of project types and learning outcomes.

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).

- - o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry (pages 58-83).~~
  - o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN Visual Art: Tennessee Visual Art: Visual Art standards 1.3, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, and 5.3 may provide additional insight and activities for educators.~~
- ~~TN Visual Art History: Tennessee Visual Art History: Visual Art History standard 2.1 may provide additional insight and activities for educators.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Digital Arts & Design III

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6087
Prerequisite(s):	*Digital Arts & Design II* (6086)
Credit:	1-2 (See Recommended Credits Below)
Grade Level:	11-12
Graduation Requirements:	This course satisfies one to two of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the third course in the *Digital Arts & Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	153, 230, 311, 435, 436, 475, 476, 516, 519, 520, 521, 537, 538, 543, 576, 583, 597, 710, 711
Required Teacher Certifications/Training:	ADDA Certified Digital Designer or NOCTI Advertising & Design or Adobe Certified Expert
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

Digital Arts & Design III is the third course in the *Digital Arts & Design* program of study. Applying design skills developed in prior courses, students will expand their creative and critical thinking skills to create comprehensive multimedia projects and three-dimensional designs. Upon completion of this course, proficient students will be able to use industry-standard software to create multimedia projects, web

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pages, three-dimensional models, and animations. Students will utilize research techniques to plan and enhance project outcomes. Standards in this course also include professionalism and ethics, career exploration, and business and project management. In addition, students will continue compiling artifacts for inclusion in a digital portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee Visual Art standards.*~~

Program of Study Application

This is the third course in the *Digital Arts & Design* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one credit or two credits, this course leads to a fourth-level *Applied Arts Practicum* course in which students apply the skills learned here toward the completion of an in-depth, semester- or year-long project. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Recommended Credit

If all standards in the course are covered, the course is recommended for two credits.

If only one credit is to be offered, two options are recommended. Option A focuses more on multimedia and web applications. Option B is tailored for programs with a specific interest in or capacity for teaching animation.

1 Credit - Option A

Content	Standards
Safety	1
Professionalism & Ethics in Design	2, 3
Career Exploration	4
Multimedia	5, 6
Web Applications	7, 8, 9
Three-Dimensional Graphics	10, 11
Research Project	21
Design Projects	22, 23, 24
Business Management	25, 26
Portfolio	27

1 Credit - Option B

Content	Standards
Safety	1
Professionalism & Ethics in Design	2, 3
Career Exploration	4
Three-Dimensional Graphics	10, 11
Animation	12, 13, 14, 15 16, 17, 18, 19, 20
Research Project	21
Design Projects	22, 23, 24
Business Management	25, 26
Portfolio	27

Course Standards

Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with art and design applications: the use of adhesives; hand tools; machines; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
    a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
    b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
    c. Complete a safety test with 100 percent accuracy. For equipment used in the course, complete equipment examinations with 100 percent accuracy in which the student performs an operational checkout by the instructor. Maintain a record of safety examinations and equipment examinations.
    (TN Reading 3, 4)

Professionalism and Ethics

2) Collaboratively develop a professionalism rubric for professional attributes required within art and design professions. Research job descriptions, career information, and online job boards to determine general employability skills and character traits most often mentioned or desired for digital art and design professionals. For each item on the rubric, define the characteristic, state why it is important for professionals working in these fields, and list performance indicators for the skill. Possible skills include:
    a. Creative design skills
    b. Ethical business practices
    c. Honesty
    d. Respect
    e. Communication
    f. Responsibility
    (TN Reading 1, 4; TN Writing 2, 4, 7, 8)

3) Examine current and emerging ethical and legal issues related to the digital art and design industry (e.g., copyright, font licensing, piracy, photo manipulation, sustainability). Choose one such issue and develop a claim about its impact on society and the responsibility of the digital art and design professional. (TN Reading 8; TN Writing 1, 4, 9)

Career Exploration

4) Research the range of credentials one can earn with advanced study of art and design at the postsecondary level (i.e., technical certification, BA, BS, MFA, etc.). Investigate both in-state and out-of-state postsecondary programs in a variety of digital art and design fields, including but not limited to graphic design, photography, industrial design, digital media, animation, and more. Synthesize research conducted in previous Digital Arts & Design courses to update the portfolio career plan to achieve post-high school goals. (TN Reading 5, 7, 9; TN Writing 2, 4, 6, 8)

Multimedia

5) Drawing on research from industry journals and similar publications, analyze how the principles of design converge with digital technology and imagery in motion graphics and multimedia. Select a multimedia product and explain how the principles of design work in harmony with technical skills such as creating visual layouts, illustrations, and photographs to achieve the final product. (TN Reading 1, 2, 4, 5; TN Writing 2, 9; TN Visual Art 2.1)

6) Apply the design process to complete advanced multimedia projects of increasing complexity for a range of applications such as print, web, film, and marketing communications. Demonstrate the ability to select and use the appropriate tools and procedures to accomplish project goals. Gather and arrange image, audio, and media for incorporation into comprehensive media projects. For example, create an interactive presentation that a client could use as a marketing and educational tool for potential customers.

Web Applications

7) Research design constraints affecting the design of graphics and layouts for web devices, including computers and mobile devices. Describe how design processes for the web differ from design processes for print or product creation. Evaluate and critique webpages based on the principles and elements of design and other considerations related to user friendliness and navigability. (TN Reading 1 9; TN Visual Art 2.2, 5.1, 5.3)

8) Apply illustration, photography, and layout skills to create interactive media for use on the web. For example, create a navigation bar, logo, or banner to incorporate in a web page. (TN Reading 3, 4)

9) Describe the steps involved in creating webpages. Use a content management system or web design software to create a simple informative webpage. Apply the principles of design and composition. Prepare images and illustrations in the proper format for use on the web. For example, as part of a design package for a client, create a mock-up of a webpage incorporating color schemes and graphics that coordinate with the design package. (TN Reading 3, 4; TN Writing 4; TN Visual Art 2.1)

Three-Dimensional Graphics

10) Research and compile examples of digital three-dimensional modeling and graphics created by design professionals in a range of industries, such as entertainment, health sciences, architecture, engineering, aerospace, advertising, and graphic design. In a visual display such as an infographic, evaluate examples from at least five industries, citing the sources used. (TN Reading 1, 2, 7, 9; TN Writing 2, 6, 7, 9)

11) Perform multistep procedures in industry software to create three-dimensional models of increasing complexity. Apply design principles, mathematical concepts, and software tools to develop the design, including but not limited to:
   a. Applying surface materials
   b. Creating a background environment
   c. Adding lighting features to create shading and shadow effects

d. Calculating area, diameter, circumference, and volume for two- and three-dimensional objects employing related geometric terminology
e. Positioning cameras to set up scenes
f. Rendering the models to create finished products
g. Generating videos of three-dimensional models such as walkthroughs or flyovers
(TN Reading 3, 4; TN Math N-Q, G-GMD, G-MG; TN Visual Art 2.1)

Animation

12) Synthesize research from informational texts, including industry magazines and online resources, to create an annotated timeline or visual graphic emphasizing significant time periods, technological advances, and key figures in animation. (TN Reading 2, 7; TN Writing 2, 9)

13) Research and report on the principles of animation. Examine movies, cartoons, or other animations to identify applications of the principles of animation. As a class, create, review, and revise a presentation explaining the principles of animation by citing resources and identifying examples in works of animation. (TN Reading 1, 2; TN Writing 2, 5, 6, 8, 9)

14) Describe the animation process, outlining the steps involved in planning, creating, and editing an animation. Drawing on research, perform multistep procedures to develop a three-dimensional animation. Steps should include:
    a. Brainstorming to develop an idea
    b. Conducting research to determine the target audience
    c. Conducting research to develop visual ideas
    d. Producing sketches of the presentation
    e. Creating an environment for the animation
    f. Applying the principles of animation toward the completion of a working animation

15) Create a storyboard to develop animation concepts. The storyboard should present visual elements of the animation, illustrations of the sequence of actions, and major themes and ideas. Present the storyboard to peers for evaluation. Revise and refine the storyboards based on constructive feedback. (TN Reading 3, 4; TN Writing 4, 5, 6)

16) Apply three-dimensional modeling skills to create the elements of an animation, including creating, modifying, and manipulating polygonal objects and creating and applying surface textures. (TN Reading 3, 4)

17) Compare and contrast the properties and uses of different types of lighting for an animation scene, including three point lighting, animated lighting, indirect and direct lighting, and environmental lighting. Use software tools to apply appropriate lighting to the scene, utilizing the principles of design and animation. (TN Reading 1, 2, 4, 9; TN Visual Art 2.1)

18) Follow multistep procedures to use cameras, including animated cameras, to create animations. Demonstrate the ability to bring conceptual ideas from the storyboards to fruition. (TN Reading 3)

19) Utilize animation software to understand and apply the mechanics of animation. Apply basic software techniques to create animations. Techniques include the following:
    a. Create and modify key frames and poses

b. Change an objects state or position over time
c. Establish an object's speed
d. Move an object along a path
e. Apply basic rigging to a model

For example, utilize software tools to simulate a mechanical cycle such as a ball dropping and bouncing. (TN Reading 3, 4)

20) Apply various animation effects when working on animation projects, including particle systems, environmental simulation (wind, gravity, time), and other effects. Use appropriate rendering settings to render a sequence of frames. Save the file in appropriate formats for given applications and explain why a particular format is most acceptable for the selected application and audience, such as the use of a .swf file on a webpage. (TN Reading 3, 4; TN Writing 4, 9)

Research Project

21) In preparation for a design project, perform in-depth research to investigate the context of the project's use and the potential users of the project. Create an informative essay describing the context of the design, citing both qualitative and quantitative research. For example, for a three-dimensional animation of a product's design, make a claim for the targeted audience and the environment in which the product will be used, citing specific textual evidence to support the claim. (TN Reading 1, 2, 4, 6, 9; TN Writing 2, 4, 8, 9)

Design Projects

22) Apply the design process to complete projects of increasing complexity, combining multiple media to communicate, market, or advertise across different platforms, including print, web, film, and other digital forums, in order to maximize audience reach and reinforce message. Describe why multiple media are needed to accomplish project goals; specifically, justify why a web-based format is appropriate for one audience whereas a print format is more appropriate for another. Demonstrate the ability to select and use the appropriate tools, procedures, and project management techniques to accomplish project goals. Prepare a persuasive narrative to explain the project to a client, communicating the project in such a way that is understandable to the audience. (TN Reading 3, 4, 5, 7; TN Writing 1, 4; TN Math N-Q, G-MG)

23) Utilize the critique and refinement strategy as part of the design process to achieve project goals. As part of a design project, present preliminary design ideas in a way that is understandable to an audience using both visual and verbal explanations. Note constructive criticism received and use it to influence design refinement. Similarly, evaluate the work of others, drawing on design principles and project goals to provide clear, specific, and constructive feedback. (TN Writing 4, 5, 6; TN Visual Art 1.3, 2.1, 2.2, 5.1, 5.3)

24) Complete a project using multiple software applications. Determine the appropriate software for each specific task and efficiently manage file content. Convert and export files as needed for the given application. For example, import photographs and illustrations into three-dimensional modeling software by appropriately linking the files. (TN Reading 3, 5)

Business Management

25) Analyze the components of a professional design proposal. Write an informative text describing the purpose of each element of a proposal. Include strategies for the designer to use to generate the information contained in each section. (TN Reading 4, 5, 6; TN Writing 2, 9)

26) Use an online editing tool to develop a professional proposal for a specific project. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. (TN Reading 1, 7, 8; TN Writing 2, 6, 8)

Portfolio

27) Update the digital portfolio to reflect the cumulative total of all projects undertaken across the program of study. Compile information, sketches, photographs, illustrations, layouts, and design projects from each course. Include artifacts that demonstrate ability to use industry-specific technology. Select projects from course work that showcase qualifications as a design student. Upon completion of this course, the following artifacts should reside in the student portfolio:
    a. Career plan
    b. Professionalism rubric
    c. Example designs showing best work from each course

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry (pages 58-83).
    o Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.

- ~~TN Visual Art: Tennessee Visual Art: <u>Visual Art</u> standard 1.3, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, and 5.3 may provide additional insight and activities for educators.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

A/V Production I

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6049
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the first course in the *A/V Production* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	538, 576, 597, 710
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

A/V Production I is a foundational course in the Arts, A/V Technology, & Communications cluster for students interested in A/V (audio/visual) production occupations. Upon completion of this course, proficient students will be able to explain and complete the phases of the production process including pre-production, production, and post-production. Students will establish basic skills in operating

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cameras, basic audio equipment, and other production equipment. Standards in this course include career exploration, an overview of the history and evolution of A/V production, and legal issues affecting A/V production. In addition, students will begin compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee State Standards for Physical World Concepts, Physical Science, Physics, and Visual Art.*~~

Program of Study Application

This is the first course in the *A/V Production* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply in a written, oral, or digital presentation using domain-specific terminology. ~~(TN Reading 3, 4, 6)~~

2) Explain the intended use of equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with equipment. Incorporate safety procedures and complete a safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

3) Determine the safety considerations for working both in the studio and in the field. Create a hazard assessment checklist and perform safety inspections for various environments, including a classroom studio. ~~(TN Reading 3, 4; TN Writing 4)~~

History and Evolution of A/V Production

4) Research the development of A/V production throughout history, analyzing how advances in technology have impacted the industry. Create an annotated timeline or visual graphic illustrating the significant people, time periods, and technological advances affecting A/V production. Citing resources from informational texts, include justification for why each identified item is significant. ~~(TN Reading 1, 2, 4, 5, 7; TN Writing 9)~~

5) Analyze the impact A/V productions have on society. Investigate the role of media in communicating ideas in society, emphasizing how social, cultural, economic, and political developments are reflected in and influenced by media, including the impact of social media on A/V production. For example, compose a persuasive essay describing how a given social media application has positively or negatively impacted society, such as the rise of cyberbullying on social networks or how non-profit organizations use social media to fundraise. ~~(TN Reading 1, 2, 4; TN Writing 1, 4, 9)~~

Career Exploration

6) Research A/V production occupations, such as film and video editor, A/V equipment technician, broadcast engineering technician, multimedia animator, camera operator, announcer, producer, director, or reporter. Interpret labor market data, such as information from the Bureau of Labor Statistics and O*Net OnLine, to identify the industries in which A/V production professionals work, including but not limited to the motion picture industry, radio and television broadcasting, advertising, and more. Determine areas of largest growth and discuss emerging trends and careers in A/V production-related industries. (TN Reading 1, 2, 4; TN Writing 9; TN Math S-ID)

Ethical and Legal Issues

7) Investigate the laws impacting the work of A/V production professionals. Accurately describe the First Amendment to the U.S. Constitution and make a claim about its impact on the media industry, citing specific textual evidence from landmark legal cases. (TN Reading 2, 5; TN Writing 1, 4, 9)

8) Drawing evidence from a variety of resources, conduct a short research project to evaluate the proper procedures for legally obtaining and using content for production purposes, including attribution procedures. Examine copyright laws and fair use. In a written, oral, or video presentation, summarize and explain the legal concerns for creating, obtaining, or sharing a production as though leading a training or tutorial for fellow employees. Include the use of property and talent releases. (TN Reading 2, 3, 4, 6; TN Writing 2, 4, 7)

Introduction to the Production Process

9) Explain the production process as described in textbooks, professional websites, and by industry professionals. Describe the components of each phase of production, including pre-production, production, and post-production. Exhibit findings in a written, oral, or digital presentation, citing resources used. (TN Reading 3, 4, 5; TN Writing 2, 4, 6)

Production Equipment

10) Examine the features and functions of various types of video cameras. Explain the interrelationship between f-stops, the iris, and aperture in controlling light, and relate concepts to the physical laws that govern light and other optical phenomena. Differentiate between the focal length and the focal point related to a zoom lens. Describe how to focus a camera and explain the depth of field. Describe the importance and procedures for setting white balance. Summarize the purpose and steps of camera settings in a checklist that a camera operator could use to prepare a camera for capturing video in various environments. (TN Reading 1, 2, 3, 4, 9; TN Writing 4, 9; TN Physical World Concepts 3, TN Physics 4)

11) Analyze the rules of composition and elements of design as related to composing camera shots (i.e. the rule of thirds, field of view, lead room, color, lines, etc.). Examine videos, artwork, and photographs to identify examples of the rules of composition in use and evaluate the impact on the scene. Create a visual presentation to describe the rules of composition, citing examples and counterexamples from various resources. (TN Reading 3, 4, 9; TN Writing 6, 9; TN Visual Art 2.1, 2.2)

12) Distinguish among different types of tri-pods and other camera mounting devices. Demonstrate the proper procedures for setting up a camera on a tripod. Analyze and describe the various types of camera angles, shots, and movements in an infographic or demonstration. Correctly use the proper equipment and procedures to capture video footage. (TN Reading 3, 4)

13) Select the appropriate camera and basic accessories for a given production location. Properly set up the camera including positioning and mounting the camera and connecting the necessary cables. Demonstrate proper procedures to clean and store cameras and equipment. (TN Reading 3, 4, 9)

14) Examine the basic types and applications of various lighting equipment. Compare and contrast studio and field lighting equipment and techniques. Evaluate light quality in terms of intensity, color, direction, and other characteristics. Describe a variety of lighting techniques, including one, two, and three point lighting techniques; demonstrate the ability to provide written specifications for required lighting setups, as a set designer would instruct a gaffer. Employ proper lighting equipment according to industry safety standards. (TN Reading 3, 4, 5, 8, 9; TN Writing 2, 4)

15) Examine the scientific properties and principles of sound, including how sound travels and how digital audio is created. Citing textbooks and online resources, create an informational text with supporting graphics illustrating the principles. (TN Reading 2, 3, 4, 5; TN Writing 2, 4, 6, 7, 9; TN Physical World Concepts 3, TN Physical Science 2)

16) Utilize the knowledge of microphones and scientific principles of sound to appropriately select and place microphones for a given production. Connect microphones to camera equipment and other audio equipment using the proper cables. Compare and contrast the types, uses, and pick-up patterns of various microphones. Create a visual display illustrating pick-up patterns of microphones and listing example scenarios when each is commonly used. Experiment with different microphones and predict the pick-up pattern of each. Consult instructional manuals and manufacturer online resources to evaluate if the conclusions are correct. (TN Reading 2, 3, 4, 9; TN Writing 7, 9; TN Physical World Concepts 3, TN Physical Science 2)

Planning a Production

17) Describe the elements of a story, such as characters, setting, conflict, and resolution. Distinguish among the script styles and writing techniques for different types of productions, including but not limited to news broadcast, documentary, fictional narrative, and advertising. Select at least one example of a fact-based script, an entertainment-based script, and an advertising-based script. Investigate the scripts to compare and contrast the elements of each type. Summarize findings in an informational text, citing evidence from research. (TN Reading 2, 3, 4, 6, 9; TN Writing 2, 9)

18) Utilize the steps of the pre-production phase to create a written plan for a simple production. Conduct a pre-production meeting to develop a production plan. The plan should include but would not be limited to:
   a. Justifying the purpose of the production
   b. Determining the target audience
   c. Writing a script for the production

      d. Creating a project budget

      e. Outlining a production schedule

      f. Choosing a method of content delivery (i.e., online, on radio, on television, live production, etc.)

Justify all recommendations for the budget, production schedule, and method of delivery, then prepare a brief written pitch to a mock funder or studio. Argue for the merits of the project using persuasive language and supporting evidence. ~~(TN Reading 3, 4; TN Writing 1, 4, 9)~~

Capturing a Production

19) Select and set up the most appropriate production equipment for a chosen production location. Properly use the appropriate equipment, camera and/or microphone techniques, and composition principles to capture video and/or audio according to a pre-production plan. ~~(TN Reading 3, 4)~~

Post-Production

20) Demonstrate common procedures to manage digital files and distinguish between the various types of digital video, image, and audio files. Describe file storage in cameras and calculate the amount of recording time a device can hold based on the settings. Log, upload, and organize video and/or audio resources in preparation for editing, converting file formats as necessary. Utilize online file management services to backup files. ~~(TN Reading 3, 4, 9; TN Writing6, 9; Math N-Q)~~

21) Perform basic software operations to edit videos and/or audio, including assembling clips for proper sequencing, applying transition effects, and inserting basic text to enhance video (i.e. captions and credits). Utilize digital video and/or audio editing software to individually perform post-production procedures to create a short production, such as a three-minute film, news report, or radio broadcast. ~~(TN Reading 3, 4, 7; TN Writing 4, 6)~~

Projects

22) Apply the production process to independently complete video and/or audio projects for a public audience. Demonstrate the ability to set goals according to the project plan, and select and use the appropriate equipment and procedures to achieve goals. Prepare an informative narrative to explain the final product to a peer, emphasizing how the production process, composition rules, and scientific principles were applied. ~~(TN Reading 3, 4, 7; TN Writing 2, 4)~~

23) Create a rubric to evaluate the effectiveness of a production based on the rules of composition and project goals. Use the rubric to reflect upon project outcomes and gather feedback from peers. Note constructive feedback received, and use it to improve the outcomes of future projects. Similarly, evaluate the work of others, drawing on composition rules and project goals to provide clear, specific, and constructive feedback. ~~(TN Reading 2, 4, 9; TN Writing 5, 9)~~

Portfolio

24) Gather examples of professional portfolios from contemporary videographers and journalists. List the items that are often included in a professional portfolio. In a written, visual, or oral presentation, describe the components of a professional portfolio and the benefits of maintaining one. ~~(TN Reading 1, 4, 9; TN Writing 2, 4, 8, 9)~~

25) Compile relevant artifacts to create a student portfolio connecting personal career preparation to concepts learned in this course, including written descriptions of project processes and reflections on learning outcomes. ~~(TN Writing 4)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Statistics (pages 58-83).~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN Physical World Concepts: Tennessee Science: Physical World Concepts standard 3 may provide additional insight and activities for educators.~~
- ~~TN Physical Science: Tennessee Science: Physical Science standard 2 may provide additional insight and activities for educators.~~
- ~~TN Physics: Tennessee Science: Physics standard 4 may provide additional insight and activities for educators.~~
- ~~TN Visual Art: Tennessee Visual Art: Visual Art standards 2.1 and 2.2 may provide additional insight and activities for educators.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

A/V Production II

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6050
Prerequisite(s):	*A/V Production I* (6049)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the second course in the *A/V Production* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	538, 576, 597, 710
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

A/V Production II is the second course in the *A/V Production* program of study intended to prepare students for a careers in audio/visual production. Building on knowledge acquired in *A/V Production I*, this course advances technical skill in utilizing industry equipment related to lighting and audio, and it places special emphasis on the research and technical writing involved in planning productions. Upon

Approved January 30, 2015

completion of this course, proficient students will be able to plan, capture, and edit research-based productions of increasing complexity, individually and through collaboration in teams. In addition to more robust career preparation, standards in this course include an investigation of concerns affecting A/V production businesses, such as ethical and legal issues, technology, funding, and the organization of professional roles in various industries. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Physical World Concepts, Physical Science, and Physics.*~~

Program of Study Application

This is the second course in the *A/V Production* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply in a written, oral or digital presentation using domain-specific terminology. ~~(TN Reading 3, 4, 6; TN Writing 4, 9)~~

2) Explain the intended use of equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with equipment. Review the hazard assessment checklist from the introductory course and update as needed for various environments. Incorporate safety procedures and complete a safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

A/V Production Industries

3) Analyze how A/V professionals interact with others within industry. Conduct a case study of a company to evaluate the roles and responsibilities of A/V production professionals within the company. Create an oral, written, or visual presentation to illustrate the similarities and differences among the various roles. For example, investigate how an audio or video editor interacts with producers, directors, cinematographers, and assistants in a motion picture company to create a movie trailer. ~~(TN Reading 1, 2, 4, 5; TN Writing 2, 8, 9)~~

4) Develop a research paper, video production, or visual display demonstrating the influence of technology on the careers of A/V production professionals, including the impact on technical work and business management. Write persuasively to make a claim about the personal traits and skills needed for professionals in the field as technology advances, citing an example of an emerging or future technology. ~~(TN Reading 2, 4; TN Writing 1, 4, 8, 9)~~

5) Examine funding methods for various types of productions, including private equity and capital investment, tax incentives, and grants. Describe the relationship between A/V productions and advertising. Select a production type and describe how a specific project is funded, including the role advertising plays in the project, citing examples and identifying key personnel involved in production finance. Use technology to compile the information as a class and create a library of production types, with example funding strategies for each. (TN Reading 1, 2, 4, 9; TN Writing 4, 6, 8, 9)

Career Preparation

6) Research the postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer A/V production-related programs. Based on the research, determine how postsecondary study and other advanced training help facilitate career development. Identify specific occupations of interest, outline preliminary employment goals, and devise a tentative career plan to reach those goals. Include in the plan descriptions of admissions criteria, postsecondary programs of study, and the secondary courses that will prepare a student to be successful in a chosen A/V career. (TN Reading 1, 2, 3, 5; TN Writing 4, 7, 9)

Ethical and Legal Issues

7) Examine the significance of ethical practices in A/V production occupations, using professional organizations' codes of ethics or other industry sources. Evaluate ethical issues affecting the industry, such as truth telling in broadcast journalism and cultural sensitivity. Compose an argument with claim(s) and counterclaim(s), debating the sociological and economic impact of a particular issue facing the industry. (TN Reading 1, 2, 8, 9; TN Writing 1, 4, 8, 9)

Production Writing

8) Employ research methods when planning a production, including data collection, critical reading, and analysis of such information as casting tapes or location scouting reports. Synthesize research to draw conclusions and present a claim, citing resources and articulating logical rationale for the use of chosen resources. For example, conduct a survey to determine student body opinions regarding a current news event. (TN Reading 1, 8, 9; TN Writing 1, 4, 8, 9)

9) Utilize research methods to determine the target audience for a given advertising production. Analyze the wants and needs of the target audience to prepare persuasive writing to communicate the intended message to the viewer. Create a distribution plan to deliver the content to the target audience such as through television, radio, email, websites, and/or social media. (TN Reading 1, 2, 6; TN Writing 6, 9)

10) Building on the experiences and knowledge from *A/V Production I*, conduct research and write scripts for various production types. Analyze and break down the components of each type to create narratives that communicate the desired message or story with a logical beginning, middle, and end. Produce, review, and revise a script for each of the following production types, utilizing the appropriate style and formatting conventions of each:
    a. Entertainment-based productions
    b. Fact-based productions

     c.   Market-based productions, such as advertising and proposals
(TN Reading 6, 9; TN Writing 4, 5, 6, 8, 9)

Interviewing

11) Examine interviewing techniques used in A/V production. Create an interviewing plan outlining the selected topic, interviewees, interview location, and scheduling plan. Include justification for why the selected interviewees and location are appropriate for the given topic, noting any potential biases that may exist. (TN Reading 3, 4, 9; TN Writing 4, 9)

12) Analyze techniques used for writing interview questions. Compare and contrast a variety of example interview questions to determine the characteristics of quality interview questions, such as those which evoke detailed responses. Recognize the properties of biased and unbiased questions. Create a library of example questions a professional could use to prepare for interviews. (TN Reading 6, 9; TN Writing 4, 5, 9)

13) Drawing on research, create a list of interview questions for a specified interview with a specific purpose and audience. Evaluate the questions for bias and quality. Perform interviews using prepared questions, appropriately improvising based on responses. (TN Reading 6)

Planning a Production

14) Explain the components and function of storyboards for A/V productions. Search for short scripts or draw excerpts from larger texts in order to analyze and prepare them for conversion into storyboards. For the identified production, create an original storyboard based on the written script. (TN Reading 3, 4, 5, 7; TN Writing 4, 5, 6, 9)

15) Utilize the steps of the pre-production phase to create written plans for productions of increasing complexity. Conduct a pre-production meeting to develop production plans. The plans should include but would not be limited to:
    a.   Justifying the purpose of the production
    b.   Researching the topic of interest
    c.   Determining the target audience
    d.   Writing a script for the production based on research
    e.   Crafting a storyboard
    f.   Creating a project budget
    g.   Outlining a production schedule
    h.   Choosing a method of content delivery (i.e., online, on radio, on local television, live production, etc.)
For example, research a popular or controversial topic within A/V production, and create a production plan for a well-organized, short documentary film or radio news story that explores expert opinion on both sides of the debate. Sample topics include the portrayal of athletes as positive role models or the prevalence of violence on television. (TN Reading 2, 3, 4; TN Writing 4, 5, 6, 7, 8, 9)

Lighting

16) Examine the scientific principles of light, distinguishing among the characteristics of hard light, diffused light, and incident light. Describe techniques used for manipulating light such as filters, gels, diffusers, and more. Utilizing these principles and building on techniques learned in *A/V Production I*, plan and implement the lighting for a production scene. Steps include planning the scene and equipment, blocking the scene, setting the lights, and adjusting the white balance of the camera. ~~(TN Reading 2, 3, 4, 5; TN Physical Science 2; TN Physical World Concepts 3; TN Physics 4)~~

17) Analyze how lighting techniques are used to create composition, visual continuity, and mood by examining case studies of video productions. Examine a given production and formulate a hypothesis concerning the types and setup of lighting equipment used for the scenes. Corroborate the hypothesis where possible and illustrate the conclusions in a written narrative with supporting graphics (such as a lighting set-up diagram). Formulate a strategy for creating a given mood by studying and citing examples from textbooks, online resources, and results of the case study. ~~(TN Reading 2, 3, 4, 5, 9; TN Writing 7, 8, 9)~~

Audio

18) Describe the importance and characteristics of quality audio, drawing conclusions about production results and implications based on audio quality. Explain the proper techniques for capturing quality audio for productions. Cite sources employing both scientific and industry perspectives, briefly justifying why each is valid. ~~(TN Reading 1, 2, 4, 8)~~

19) Properly set up audio recording equipment and perform a pre-production check. Record an audio sequence and properly monitor the sound level. Troubleshoot poor sound quality and interferences by identifying the source of the problem and making corrections. Record quality sound, both in the studio and on location. ~~(TN Reading 3, 4, 9)~~

Production Equipment

20) Design the staging and layout of a set. Appropriately integrate lighting, audio, scenery, costumes, and props according to the script and production plan. In teams, demonstrate the proper setup and operation of a wide array of production equipment, and rotate roles to complete the various jobs necessary for a studio and/or remote production. ~~(TN Reading 3)~~

21) Demonstrate camera operations of advancing skill in studio and field environments including:
    a. Selecting proper framing
    b. Capturing action footage
    c. Using appropriate lens focal length, aperture, and exposure
    d. Implementing appropriate recording sequence
    ~~(TN Reading 3, 4)~~

22) Identify and describe the function of the equipment in a control room. Appropriately use an audio mixer, switch cameras, and utilize traffic control equipment. Drawing on instructional manuals and other resources, create a short tutorial video that a beginning A/V production

student could view to understand the basic functions of a control room. ~~(TN Reading 2, 3, 4, 9; TN Writing 4, 6, 8)~~

23) Interpret instructional manuals and other resources to determine and demonstrate routine maintenance and cleaning procedures to protect and prolong the life of A/V production equipment. Create a maintenance plan for a given piece of equipment that another peer could use to perform proper cleaning and storing techniques. ~~(TN Reading 2, 3; TN Writing 4, 8, 9)~~

24) Perform troubleshooting procedures, including researching solutions used by A/V technicians, to solve basic technical problems involving production equipment. For example, examine a malfunctioning piece of equipment or improperly set-up network of equipment and determine the cause of the malfunction. Apply knowledge gained through experience in the course and employ research procedures to fix the equipment, adjust the settings, and prepare for production. ~~(TN Reading 2, 3, 9)~~

Post-Production

25) Examine the importance of post-production editing to the A/V production process, and determine the impact of editing on continuity, performance, emphasis, and pacing. Perform advancing software operations to edit video and/or audio clips. Build on the skills learned in *A/V Production I* (assembling clips for proper sequencing, applying transition effects, and inserting basic text to enhance video) to complete more sophisticated tasks, including:
    a. Adjusting audio levels for balance and emphasis
    b. Using multiple audio sources
    c. Mixing audio for video such as applying sound effects, equalizing, and matching levels
    d. Applying visual effects such as filters, keying, and image control
    e. Creating graphics for video productions such as titles and still images
    f. Exporting and uploading video and/or audio in the appropriate format based on its planned distribution
Utilize digital editing software to create productions of increasing complexity, such as a documentary film that incorporates photographs, interviews, narrative voice-over, and other footage. ~~(TN Reading 3, 9)~~

Projects

26) Apply the production process to complete video and/or audio projects (independently and in teams) for a public audience of increasing complexity and of varying type. Demonstrate the ability to select and use the appropriate equipment and procedures to accomplish project goals. Create a narrative to promote the production to a targeted audience. For example, write a synopsis of a short film, as though for a movie listing. ~~(TN Reading 3; TN Writing 2, 4)~~

27) Reflect on the outcomes of productions created in the course. Evaluate whether the various elements of the production meet the goals set in the production plan. Additionally, evaluate the productions of others, assuming the role of a film critic or analyst to write a critical review of a production, citing evidence to justify claims made. ~~(TN Reading 9; TN Writing 21 4, 5, 9)~~

Portfolio

28) Update materials from coursework to add to the portfolio started in *A/V Production I*, including the career plan generated in this course, and continually reflect on coursework experiences. Include written descriptions of project types and learning outcomes. (TN Writing 4,)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Physical World Concepts: Tennessee Science: Physical World Concepts standard 3 may provide additional insight and activities for educators.
- TN Physical Science: Tennessee Science: Physical Science standard 2 may provide additional insight and activities for educators.
- TN Physics: Tennessee Science: Physics standard 4 may provide additional insight and activities for educators.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

A/V Production III

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6083
Prerequisite(s):	*A/V Production II* (6050)
Credit:	1-2 credits (See Recommended Credit below)
Grade Level:	11-12
Graduation Requirements:	This course satisfies one to two of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the third course in the *A/V Production* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	538, 576, 597, 710
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

A/V Production III is an applied-knowledge course intended to prepare students to pursue careers and postsecondary learning in audio/visual production. Students in this course will apply knowledge and skills from previous courses in the program of study to create productions both independently and in teams, with the option of participating in a work-based learning experience for additional credit.

Approved January 30, 2015; Amended April 15, 2016

Students will use industry equipment and technology to complete all phases of the production process, including planning, coordinating, capturing, editing, and distributing productions. Standards in this course include policies and regulations, independent and collaborative productions, distribution of media, and the production of live events. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. Upon completion of this course, proficient students will be prepared for a career in audio/visual production or to transition to a postsecondary program for further study. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

Program of Study Application

This is the third course in the *A/V Production* program of study. Flexibility is built in to offer this course for either one or two credits, depending on whether or not a student completes an internship. Whether offered for one credit or two credits, this course can feed into a fourth-level *Applied Arts Practicum* course in which students can apply learned skills toward the completion of an in-depth, semester- or year-long project. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Recommended Credit

If standards 1-20 are covered, the course is recommended for one credit. If all standards (1-23) are covered, the course is recommended for two credits.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply using domain-specific terminology. (TN Reading 3, 4, 6)

2) Explain the intended use of equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with equipment. Review the hazard assessment checklist from *A/V Production I* and *A/V Production II* and update as needed for various environments. Incorporate safety procedures and complete a safety test with 100 percent accuracy. (TN Reading 3, 4)

Policies and Regulations

3) Research and summarize relevant legislation, regulations, and laws regulating audio/visual production, such as Federal Communications Commission regulations and the Freedom of Information Act. Discuss the influence of government regulations on various media. (TN Reading 1, 2, 5, 9; TN Writing 8)

4) Examine labor management processes and agreements used in A/V production fields. Describe the roles and functions of unions and professional organizations. Explain how such organizations influence and impact the development of production plans and work production. (TN Reading 2, 3, 4)

Independent Production

5) Perform research to develop a project idea for a given production type. Prepare a proposal and storyboard for the proposed project and pitch the idea to industry professionals, clients, and/or peers. In the presentation, include:
   a. Justification of identified production type
   b. Determination of the target audience based on research
   c. Relevance of the project idea to targeted audience
   d. A draft of a written script based on research and appropriate to the purpose
   e. A storyboard illustrating the main ideas of the production
   Collect and reflect on constructive feedback from the audience, and incorporate feedback to develop the production plan. (TN Writing 1, 4, 5, 9)

6) Apply skills and knowledge from previous courses to independently coordinate and complete all elements of the pre-production, production, and post-production processes in order to create an original production (as outlined in standard 5) according to identified schedule and intended purpose (e.g. client requirements).

7) Assume the role of a producer to coordinate production activities. Log activities in a production log. Determine the personnel, equipment, and associated costs needed to complete the project, including anticipated scheduling, coordinating, and managing of crews to complete projects. (TN Reading 3, 4; TN Writing 4, 9)

8) Examine characteristics of high quality on-camera performances by reading textbooks and other resources and by analyzing actual professional video productions. Synthesize research to create guidelines for on-screen performances. Practice performing on-screen and identify strengths and areas to improve for future performances, both through personal reflection based on identified guidelines and by requesting constructive feedback from the instructor and/or peers. (TN Reading 2, 3, 8, 9)

9) Read and interpret instructional materials to generate special effects and animated elements for a given production using industry software. Employ the elements of design such as type, color, and composition to enhance the communication of the theme and message. For example, create and employ graphical elements consistent with a company's or broadcasting station's branding to appeal to the identified target audience. (TN Reading 2, 3; TN Writing 6)

Collaborative Production

10) Drawing on research conducted in *A/V Production II* regarding the roles of individuals within A/V production teams, determine the structure of a production team needed to complete a classroom production. Draw a diagram to illustrate the breakdown of the team. Create job descriptions to indicate the responsibilities of every position. (TN Reading 7; TN Writing 2, 4, 9)

11) Apply skills and knowledge in an authentic production laboratory. Organize a production team; assign roles based on the strengths of each individual, working collaboratively to set and complete project goals. Demonstrate professionalism, exercise leadership, and complete tasks in a timely manner according to the production schedule. (TN Reading 3)

12) Schedule and conduct team project meetings as needed throughout all phases of production, emphasizing team goals and values. For example, conduct meetings to brainstorm and refine project ideas, prepare for production, coordinate logistics, address challenges as production is implemented, and to plan and delegate editing and distribution responsibilities during post-production.

13) Work in production teams to complete all aspects of the production process including planning, coordinating, capturing, editing, and distributing a production. Demonstrate advanced skills in selecting, setting up, and using industry equipment and software. Utilize advanced scheduling techniques to manage extended projects by developing a Gantt chart, monitoring production processes, and appropriately adjusting plans in response to problems or delays. (TN Writing 6)

14) Reflect upon project outcomes, evaluating the results based on project goals. Evaluate team operations and identify opportunities to improve functioning processes of the team. As a group, evaluate the effectiveness of production content and implementation based on audience feedback, ratings, etc. Note constructive and positive feedback received, and incorporate feedback to improve the outcomes of future projects. (TN Writing 5, 7, 9)

Distribution of Media

15) Research outlets for media distribution. Explain the techniques and procedures of online distribution (e.g., web hosting, streaming, social media), television broadcast and cable networks, radio broadcast and networks, syndication, and public broadcast. Compare and contrast each in an infographic or written narrative, citing evidence from the sources consulted. (TN Reading 1, 2, 4, 7, 9; TN Writing 2, 9)

16) Select a specific media outlet and research in more detail the transmission procedures of that outlet. For example, analyze methods a local news broadcasting company uses to send transmissions from a remote site to a studio, and how news broadcasts are transmitted to viewers.

17) Create a strategy to gather audience feedback utilizing technology. For example, utilize social media sites to monitor audience feedback posts or create an online survey. Gather and analyze feedback from audience responses and use it to influence future productions. (TN Writing 7, 9)

Live Events

18) Analyze the unique procedures and equipment needed to capture and stream/broadcast video and/or audio productions of live events, such as a sporting event or a performance. Summarize findings in an informational text, citing research from online resources or industry professionals. (TN Reading 1, 2, 3, 4; TN Writing 2, 4, 9)

19) Drawing on research, plan equipment setup for a live production. For a given event, create drawings (i.e., location sketches or CAD drawings) to plan the layout of equipment required for the event including cameras, lighting, audio, intercommunications, and other equipment and its connection to available electrical sources. While planning, attend to safety considerations such as the placement of cords and balancing of electrical loads. Use the drawings to develop an equipment list and determine the personnel required to capture the event. (TN Reading 3, 4, 7; TN Math N-Q, G-MG)

20) Work in teams to produce live events. Follow proper procedures to set up, use, and tear down equipment for producing live events in various contexts. Reflect on production outcomes in a journal and use the reflections to improve future outcomes.

Portfolio

21) Update the portfolio to reflect the cumulative total of all projects undertaken across the program of study. Continually reflect on coursework experiences and revise and refine the career plan generated in *A/V Production II*. Include written descriptions of project types and learning outcomes. (TN Writing 4, 5)

Internship Option**

22) Participate in a work-based learning internship experience to develop, practice, and demonstrate skills outlined in course standards. An internship must follow current Tennessee Work-Based Learning (WBL) Framework Guidelines.

23) Create and continually update a personal journal to document internship activities. Draw connections between the experience and course content, thoughtfully reflecting on:
    a. Acquired leadership and technical skills
    b. Problem-solving techniques and decision-making skills
    c. Team member participation in a learning environment
    d. Personal career development
    (TN Writing 2, 4)

24) Upon conclusion of the internship, write an informative essay summarizing the internship experience and next steps for personal and professional growth. Produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the internship. (TN Writing 2, 4, 6)

** Although a hands-on experience in work-based learning (WBL) is most ideal, it is recognized that not all students will be able to be placed in a company setting. Internship activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, to earn two credits, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and must follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the

Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity and Geometry (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Applied Arts Practicum

Primary Career Cluster:	Arts, A/V Technology, & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code:	6158
Prerequisite(s):	Minimum of 2 credits in an Arts, A/V Technology, & Communications program of study.
Credit:	1
Grade Level:	12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology, & Communications courses.
Programs of Study and Sequence:	This is the fourth course in the *Digital Arts & Design* and *A/V Production* programs of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov Technology Student Association (TSA): http://www.tntsa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	A/V Production- 538, 576, 597, 710 Digital Arts & Design- 152, 153, 230, 311, 435, 436, 475, 476, 516, 519, 520, 521, 537, 538, 543, 583, 711 and ADDA Certified Digital Designer or NOCTI Advertising & Design or Adobe Certified Expert
Required Teacher Certifications/Training:	If students are assigned in work-based learning settings, teachers must attend WBL training and earn the WBL Certificate provided by the Tennessee Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Approved January 30, 2015; Amended April 15, 2016

Course Description

The *Applied Arts Practicum* is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous Arts, A/V Technology, & Communications courses within a professional, working environment. In addition to developing an understanding of the professional and ethical issues encountered by professionals in these careers, students learn to refine their skills in problem solving, research, communication, teamwork, and project management through the completion of a course-long project. The course is highly customizable to meet local system needs. Instruction may be delivered through school laboratory training or through work-based learning arrangements such as internships, service learning, and job shadowing. Upon completion of the practicum, proficient students will be prepared to pursue postsecondary study in arts, A/V technology, or communications programs; or seek additional training or employment with the aid of the portfolio, which documents the student's work completed throughout the program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Digital Arts & Design* and *A/V Production* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Arts, A/V Technology, & Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Safety

1) Accurately read, interpret and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the studio or on the jobsite. Demonstrate how to properly inspect, use, and maintain safe operating procedures with equipment. If assigned to a school laboratory, incorporate safety procedures and complete a safety test with 100 percent accuracy. If assigned to work-based learning, follow all applicable safety requirements and guidelines outlined by the company and document completion of

training topics on the appropriate work-based learning and work site forms. (TN Reading 3, 4; TN Writing 4, 9)

Postsecondary and Career Preparation

3) Research and select a company or organization for a project in an arts, A/V technology, or communications field. Cite specific textual evidence from the organization's literature, as well as independent news articles, to summarize:
    a. The mission and history of the organization
    b. Headquarters and organizational structure
    c. Products or services provided
    d. Credentials required for employment and how they are obtained and maintained
    e. Policies and procedures
    f. Reports, newsletters, and other documents published by the organization
    g. Website and contact information
    (TN Reading 1, 2; TN Writing 4, 7)

4) Interview supervisors and other employees in a work environment to identify appropriate methods of pursuing education and employment in the given industry, and determine what knowledge, skills, and educational credentials are required in the given workplace setting. Summarize the interviews in an informative narrative. (TN Reading 2, 3, 6, 9; TN Writing 2, 9)

5) Apply learning experiences throughout the course to review and update the education and career plan based on the knowledge and feedback acquired. Proactively identify areas of strength and opportunities for professional growth, encourage and act on feedback from peers, supervisors, and customers, and seek and use resources to improve skills. (TN Reading 4; TN Writing 8, 9)

6) Search for the resumes of arts, A/V technology, and communications professionals retrieved from the websites of companies, organizations, or professional networks. Discuss what is typically included in the resumes of these professionals, compare and contrast several examples, and create a personal resume modeled after elements identified in the search. (TN Reading 1, 4, 5, 6; TN Writing 4)

7) Conduct a job search and simulate the experience by researching local employment options. In preparation for a future career in arts, A/V technology, and communications, compose a cover letter highlighting relevant experience and skills from the resume for a specific job posting. (TN Reading 7; TN Writing 2, 4)

8) Participate in a mock interview. Prior to the interview, research tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Highlight sample work compiled in the portfolio that illustrates mastery of specific skills attained throughout the program of study. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. (TN Reading 2; TN Writing 2, 4, 7, 9)

Transferring Course Concepts to Practicum

9) Apply skills and knowledge from previous courses in an authentic work-based learning internship, job shadow, or classroom-based industry project. Where appropriate, develop, practice, and demonstrate skills outlined in previous courses. (TN Reading 2, 3)

10) Work with the supervising teacher and work-based learning supervisor (if applicable) to develop a personalized student-learning plan, in accordance with approved policies, to address the methods for practicing and demonstrating each of the skills identified in the pre-requisite Arts, A/V Technology, & Communications course standards. Relate how each skill applies to a placement in the workplace or in-class setting. (TN Reading 1, 2, 3, 4, 9; TN Writing 2, 4, 6, 7, 8, 9)

11) As part of a course project, develop a comprehensive project plan to guide all work based on project planning techniques used in prior coursework. Collaboratively update the plan to reflect unexpected changes in conditions or capacity. For example, demonstrate the ability to reschedule an activity if there is a technical issue with equipment due to unforeseen circumstances. (TN Reading 3, 4, 7, 9; TN Writing 2, 5, 7)

12) Create and continually update a personal journal to document skills learned during the practicum and draw connections between the experience and previous course content by reflecting on:
   a. Tasks accomplished and activities implemented
   b. Positive and negative aspects of the experience
   c. How challenges were addressed
   d. Team participation in a learning environment
   e. Comparisons and contrasts between classroom and work environments
   f. Interactions with colleagues and supervisors
   g. Personal career development
   h. Personal satisfaction
   (TN Writing 2, 4)

Business Skills and Project Management

13) In teams, develop and successfully implement a suite of project management tools and processes to aid in the completion of the course project. (If participating in a work-based learning arrangement, apply tools and processes to satisfy placement requirements.) Demonstrate the ability to divide roles and responsibilities among team members, track progress toward goals, and satisfy client specifications as would a director, producer, or executive member of a production team. For example, assign tasks and monitor deliverables using a Gantt chart or other tracker. (TN Reading 7; TN Writing 4)

Portfolio

14) Update materials from coursework to add to the portfolio begun in the introductory course. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of project management skills specific to the industry. The following documents will reside in the career portfolio:

a. Career plan
    b. Resume
    c. List of responsibilities undertaken through the course
    d. Artifacts of project outcomes (such as storyboards, production schedules, and videos)
    e. Periodic journal entries reflecting on tasks and activities
    f. Feedback from instructor and/or supervisor based on observations
    g. Transcripts or other evidence of certifications obtained throughout the program of study

    (TN Writing 4, 5)

15) Synthesize best representations of all coursework in the program of study to create a cohesive professional webpage, digital portfolio, or video exemplifying personal accomplishments. Develop a plan to distribute the electronic portfolio as part of a career job search and/or application to a postsecondary institution. (TN Reading 1, 8; TN Writing 4, 9)

Communication of Project Results

16) Apply all steps of the production or design process to successfully complete projects as outlined in the course project plan. Demonstrate the ability to communicate results over the course of the project's duration. Produce a memo documenting the progress of the project and evaluating the final product as though writing to studio executives or project funders. Upon completion of the course, stage a live production, public screening, or other showcase to share the final product, if applicable within the work-based learning placement. (TN Reading 1, 2, 3, 4, 5, 7, 8, 9; TN Writing 1, 2, 4, 5, 6, 7, 8, 9)

17) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant artifacts, such as storyboards, casting videos, scripts, or screenshots of the finished product. Throughout the presentation, justify decisions and assess the quality of the work. Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

- - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Foundations of Fashion Design

Primary Career Cluster:	Arts, A/V Technology & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6120
Prerequisite(s):	*Visual Art I* (3501)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology & Communications courses.
Programs of Study and Sequence:	This is the second course in the *Fashion Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 059, 154, 450, 452
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

Foundations of Fashion Design introduces students to the rich history of the fashion industry and the basic design principles that are integral to its operation. This course studies the history of the fashion industry, elements and principles of design, textile history and composition, as well as basic construction principles. Upon completion of this course, proficient students will be able to demonstrate basic garment production and will create artifacts for inclusion in a portfolio, which will continue to build

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throughout the program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This is the second course in the *Fashion Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology and Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Occupational Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with textile applications: the use of adhesives; hand tools; machines; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
   a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
   b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   c. Maintain a record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.
   ~~(TN Reading 3, 4; TN Writing 4; FACS 16)~~

Career Investigation

2) Identify and analyze career pathways within the Fashion Design program of study. Cite supporting evidence from multiple sources (such as interviews with fashion design professionals retrieved from industry magazines) to summarize the essential knowledge and skills required for these careers. Complete one or more career aptitude surveys, analyze the results, and compose an essay describing the relationships between personal career aptitudes and careers in fashion design. ~~(TN Reading 1, 2, 7, 9; TN Writing 4, 8, 9; FACS 1, 16)~~

3) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to investigate local and regional occupational opportunities and trends in the fashion design industry. Synthesize collected data to develop a graphic illustration comparing occupations by education requirements, job availability, salaries, and benefits. ~~(TN Reading 2, 7, 9; TN Writing 4, 8, 9; FACS 16)~~

History and Development of Fashion Design

4) Synthesize research from informational texts, including fashion magazines and textbooks, to create an annotated timeline or visual graphic emphasizing significant time periods within fashion design dating from the beginning of civilization to the present. Using descriptive text, interpret the cultural, social, economic, and technological factors that have influenced fashion development and design. ~~(TN Reading 2, 9; TN Writing 2, 4, 7, 9; FACS 16)~~

5) Explore theories of fashion dynamics and forecasting, and compose an informative essay that illustrates the five stages of the fashion cycle concept:
    a. Introduction
    b. Rise in popularity
    c. Peak of popularity
    d. Decline in popularity
    e. Rejection

Investigate major paradigms (i.e. Circle, Pendulum) in fashion history and critique whether the fashion cycle model helps explain major paradigm shifts over time. (TN Reading 9; TN Writing 2, 4; FACS 16)

6) Analyze the importance of clothing and fashion in contemporary society as they relate to cultural, economic, and political realities in a variety of contexts around the globe. Investigate the influences of modern fashion designers; discuss how a society's customs and preferences influence what is fashionable to certain populations. Create an informational artifact that identifies significant contributions from these designers to the fashion industry. (TN Reading 9; TN Writing 2, 4, 7; FACS 16)

Elements and Principles of Design

7) Compare and contrast the elements and principles of design in visual arts and examine their interrelationships. Analyze the elements and principles of design in the context of fashion by evaluating their purpose and application in apparel and accessories.
Elements:
    a. Line
    b. Shape
    c. Proportion
    d. Color theory and basic schemes
    e. Texture
Principles:
    a. Unity
    b. Harmony
    c. Formal and informal balance
    d. Rhythm
    e. Contrast
    f. Emphasis
    g. Gradation
(FACS 16)

8) Analyze the color wheel and apply concepts of color theory to the development of fashion specs for a real or invented clothing line. Identify techniques that achieve desired hues, values, and intensities. Demonstrate the ability to color mix apparel and accessory samples in various color systems. (TN Reading 3; FACS 16)

History and Development of Textiles

9) Examine the historical development of processes and techniques in textile design and production. Using descriptive text, summarize the evolution of trends in textile colors, textures, and prints used in fashion design. Identify textile technologies that have influenced apparel design, production, merchandising, and sales. ~~(TN Reading 2; TN Writing 4; FACS 16)~~

10) Analyze research from multiple sources such as technical journals to summarize the typical products made out of textiles in the apparel industry. Compare and contrast determining factors for textile suitability and applications for a variety of commercial purposes. ~~(TN Reading 2, 7, 9; TN Writing 8; FACS 16)~~

11) Examine the progression of ethical practices in the textile and apparel industry, using historical records found in textbooks or other sources. Evaluate current ethical issues affecting the fashion industry, included but not limited to: knockoff products/designer forgeries, shoplifting, sweatshop labor, provocative advertising, and body image. Compose an argument, including development of claim(s) and counterclaim(s), debating the sociological and economic impacts of these issues on the fashion industry. ~~(TN Reading 8; TN Writing 1, 4, 9; FACS 16)~~

Textile Applications

12) Identify common fibers and describe their associated characteristics and applications. Perform swatch tests to analyze and evaluate fiber characteristics, including their aesthetic features as well as mechanical and chemical properties. ~~(FACS 16)~~

13) Analyze characteristics of natural and synthetic fibers. Compare and contrast natural and synthetic textiles with regard to performance, dying, printing, and finishing processes. Determine the suitability of various textiles for specific applications. ~~(TN Reading 9; FACS 16)~~

14) Identify common fabrics and examine basic textile fabrication processes. Research and summarize technical sources such as industry manuals or manufacturers' quality control protocol to develop a list of general instructions for the selection, evaluation, use, and care of fabrics used in fashion design. ~~(TN Reading 2; TN Writing 4, 7, 9; FACS 16)~~

15) Review informational resources identifying textile and apparel industry standards that promote quality control in apparel manufacturing. Compose an informative essay citing specific textual evidence that critiques the effectiveness and implications of these standards on product quality, cost, and supply chain dynamics. ~~(TN Reading 1; TN Writing 2, 4, 9; FACS 16)~~

Principles of Construction

16) Demonstrate basic garment construction skills and techniques. Demonstrate proficiency in proper pressing, fitting, alteration, finishing, and embellishment for quality garment construction. Demonstrate the appropriate use, selection, and maintenance of equipment, tools, and sewing supplies for the construction of apparel. ~~(TN Reading 3; FACS 16)~~

17) Demonstrate proficiency in basic pattern design and drafting techniques by designing and creating an original garment pattern. Compare and contrast skill requirements for manual and computer-aided pattern design and drafting methods. (TN Reading 3; FACS 16)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
- Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6 and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
- Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6 and 10 at the conclusion of the course.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Fashion Design

Primary Career Cluster:	Arts, A/V Technology & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6008
Prerequisite(s):	*Foundations of Fashion Design* (6120)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology & Communications courses.
Programs of Study and Sequence:	This is the third course in the *Fashion Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit /dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 059, 154, 450, 452
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

Fashion Design is an applied-knowledge course intended to prepare students to pursue careers in the fashion industry. Building on the knowledge acquired in *Foundations of Fashion Design*, this course places special emphasis on apparel manufacturing and merchandising, marketing applications, and product and service management. In addition, students will explore trends in fashion design and engage with industry-specific technologies used to produce a variety of fabrics, garments, and accessories. Upon

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completion of this course, proficient students will have created an original fashion collection. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, and National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This is the third course in the *Fashion Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology and Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Occupational Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with textile applications: the use of adhesives; hand tools; machines; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
    a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
    b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
    c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor. Compare occupational safety skills included in the portfolio to safety skills designated in authentic career postings.
    ~~(TN Reading 3, 4; TN Writing 4; FACS 16)~~

Merchandising and Promotion

2) Evaluate data from multiple sources, including textbooks and fine art books, to support analysis of the psychological characteristics of colors. For example, compare and contrast warm and cool color palettes. Craft an argument examining the effects on consumer preferences and buying trends when color psychology is employed in the marketing of fashion products. Assess the implications for the selection of fabrics for apparel and accessory design. ~~(TN Reading 7, 8; TN Writing 1, 4, 7, 9; FACS 16)~~

3) Identify fundamental techniques and design concepts of fashion merchandise presentation. Research the influence of visual merchandising on consumer purchase decisions. Create a checklist to appraise visual displays for effective and efficient use of display space, lighting, and merchandise. Apply principles of visual merchandise organization by creating an original merchandise display. ~~(TN Reading 3; TN Writing 4, 7; FACS 16)~~

4) Design a visual representation of a store layout incorporating aesthetic considerations of merchandise, services, and customers. Assess how point of view or purpose of the store layout affects content, style, and color choices. Store layout representation could include:
    a. Freeflow Layout

  b. Grid Layout
  c. Spine Layout
  d. Loop Layout
  e. Parallel Layout
 (TN Reading 6; FAC 16)

5) Examine the importance of establishing and maintaining merchandise flow processes and strategies for successful management of merchandise logistics. Compare and contrast the role of merchandise flow in evaluating and responding to the needs of the business and consumers. (TN Reading 9; FACS 16)

6) Identify promotion strategies used in the fashion industry for communication of product information. Consult sample catalogues, professional commentary, shopping apps, and related print and digital sources to determine the impact of technology and social media on fashion marketing and promotion. (TN Reading 7, 9; TN Writing 8; FACS 16)

Product and Service Management

7) Categorize types of retail clothing stores based on size, company organization (traditional, catalogue, internet), and range of products (variety or specialized). Examine how these retail stores operate within an integrated supply chain, using software such as Electronic Point of Sale (EPSO). Assess how the target population of a store shapes the content and style of the products it sells. (TN Reading 2, 7; FACS 16)

8) Analyze principles of merchandise planning and buying and explain how they relate to each other and the fashion industry as a whole. Use merchandise planning software solutions to coordinate a buying plan that includes the following elements:
  a. Selection of merchandise
  b. Establishment of retail prices
  c. Ongoing ordering processes
  d. Management of supplier relationships
  e. Strategic merchandising
  f. In-store advertising
 (TN Reading 3; FACS 16)

Marketing and Trends in Fashion Design

9) Identify basic principles of marketing, including but not limited to market analysis, planning, implementation, and control. Create a checklist of common marketing plan components (e.g., marketing objectives, customer analysis, marketing strategies, and tactics). Evaluate data and conduct an original fashion design analysis for a real or invented clothing line using the four basic elements of a fashion marketing plan:
  a. Product development
  b. Price
  c. Distribution management
  d. Promotions and communications
 (TN Reading 9; TN Writing 4, 9; FACS 16)

10) Examine components of market analysis and trends research related to fashion design (i.e., season, target market, colors, fabrics, texture, usage). Analyze how and why individuals, events, and ideas develop and interact to create seasonal fashion trends. Research and interpret technical data to forecast trends in fashion and identify target markets. (TN Reading 8; TN Writing 7, 9; FACS 16)

11) Analyze the demographics of target markets to predict consumer requirements and preferences. Integrate research and analysis data to create original fashion collections for domestic and global markets using computer-aided design applications. (TN Reading 8; TN Writing 7, 9; FACS 16)

12) Create a comprehensive seasonal buying plan using industry-related budget designing software. Formulate basic budget functions including the following elements: planning process, buy quantity, and benchmarks for progress evaluation and plan adjustment. (TN Writing 2; TN Math N-Q; FACS 16)

13) Create a window presentation for a retail store incorporating an original garment design and accessories. Create modified display options to accommodate different seasons, events, and customer demographics. (FACS 16)

Creation of Fashion Collection

14) Drawing on current and historic trends in the color, texture, and print of fabrics used for garment designs, develop a collection of apparel and accessories for different lifestyles and seasons using hand sketches or computer-aided design. (FACS 16)

15) Justify the use of certain fabrics and trims for the needs of selected target markets and garment functionalities, citing market research or industry journals to support decisions. Analyze how properties of fabrics affect garment performance and cost. Compose an informative presentation from textile choices through the product development for a chosen target market. (TN Reading 1; TN Writing 1, 2, 4; FACS 16)

16) Compile a list of materials required for a presentation board featuring a wide range of material samples. Evaluate sample elements to determine the most effective combination for creating a comprehensive fashion collection using a variety of colors, fabrics, sketches, and/or industry software designs. (TN Reading 2, 7; TN Writing 4, 8; FACS 16)

17) Assemble a presentation board that incorporates a collage of color samples, fabrics, and sketches, mounted with color renderings that logically present a particular fashion collection by color or style of design. Create a name for each garment in the collection for tracking and communication to potential clients. (FACS 16)

18) Compose and present a clear and coherent written justification for the presentation board that explains the principles of design, choice of samples, and analysis of the fashion collection. (TN Writing 1, 4; FACS 16)

19) Construct one or more garments from one of the student-designed collections developed in previous standards. Demonstrate basic garment construction skills and techniques, using

samples provided on the presentation board. Demonstrate proficiency in proper pressing, fitting, alteration, finishing, and embellishment for quality garment construction. Demonstrate the appropriate use, selection, and maintenance of equipment, tools, and sewing supplies for the construction of apparel. (TN Reading 3; FACS 16)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6 and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advanced Fashion Design

Primary Career Cluster:	Arts, A/V Technology & Communications
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6009
Prerequisite(s):	*Fashion Design* (6008)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Arts, A/V Technology & Communications courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Fashion Design* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 059, 154, 450, 452
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-arts-av-tech

Course Description

Advanced Fashion Design is the capstone course in the *Fashion Design* program of study. This course is designed to prepare students for further education and careers in the fashion industry. Through exposure to crucial business activities such as project management and product promotion, students will acquire advanced skills related to business professionalism, ethics, policies, and communication in the fashion industry. In addition, students complete a capstone project during which they will create

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artifacts to include in a professional portfolio. While not required, student internships can provide an alternative route for students to master required course standards. Students who have the opportunity to participate in internships may be responsible for the following tasks: assisting in client presentations, resource updating and vendor management, assisting designers, and participating with design teams. Upon completion of this course, proficient students will have artifacts of original fashion designs in a portfolio and will understand basic project management skills. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This is the fourth and final course in the *Fashion Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Arts, A/V Technology and Communications website at https://tn.gov/education/article/cte-cluster-arts-av-tech.

Course Standards

Occupational Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with textile applications: the use of adhesives; hand tools; machines; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
   a. Inspect, maintain, and employ safe operating procedures with tools and equipment.
   b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
   ~~(TN Reading 3, 4; TN Writing 4; FACS 16)~~

Professionalism and Ethics in Fashion Design

2) Collaboratively develop a professionalism rubric with performance indicators for each of the following professional attributes required within the fashion design industry:
   a. Creative design skills
   b. Ethical fashion business practices
   c. Honesty
   d. Respect
   e. Communication
   f. Responsibility
   ~~(FACS 16)~~

3) Examine the Ethical Trading Initiative (ETI) and summarize its governance, mission, and strategies. Synthesizing popular commentary and scholarly perspectives on the Initiative and its effectiveness assess the domestic and global significance and implications of ETI's Base Code on the textile industry and clothing market. Apply principles from the ETI Base Code to compose a

personal code of ethics to follow in the fashion design industry. ~~(TN Reading 2, 9; TN Writing 4, 7; FACS 16)~~

4) Examine current and emerging ethical issues related to the fashion design industry (e.g., fur debate, unethical labor practices, and fashion-inspired body-image disorders). Choose one such issue and develop a claim about its impact on the fashion industry's image. ~~(TN Reading 7, 8; TN Writing 1, 4, 9; FACS 16)~~

Project Management

5) Interpret and apply basic components of business plans to design and complete a comprehensive business plan for a specific fashion line. Generate formal strategies for marketing, financing, manufacturing, and labor in the context of domestic and global markets. ~~(TN Reading 7; FACS 16)~~

6) Create an outline that illustrates the basic components of project budgets commonly used in fashion design proposals (e.g., itemized budgets, non-itemized budgets, fixed budgets, and flexible budgets). Implement outline components to generate a comprehensive budget for a potential seasonal fashion line. ~~(TN Reading 3; TN Writing 4; FACS 16)~~

7) Examine how businesses in the fashion design industry conduct project management processes. Compare and contrast components of project management models gathered from case studies of major or local designers. Generate a project management template that addresses the objectives required for organizing and producing a fashion show. ~~(TN Reading 7, 9; TN Writing 4, 8; FACS 16)~~

Capstone Project

8) Demonstrate the application of advanced fashion design knowledge and skills to create a comprehensive, original fashion line with at least 10 pieces. Incorporate design and fabrication skills, technology applications and market indicators (e.g., trends, forecasting, target markets) to plan, problem-solve, and attain project goals. Project components may include but are not limited to the following:
    a. Utilize computer-aided design software to illustrate project elements
    b. Create 3-Dimensional models of project elements
    c. Select and use appropriate materials and methods to fabricate project apparel
    d. Create a design narrative board using textile samples and fashion sketches
    ~~(FACS 16)~~

9) Research the effects of brand strategies on creating product identity and enhancing sales. Examine print and digital resources to compare brand strategies used in fashion design; develop an original business logo and designer label for the fashion line. ~~(TN Reading 7; TN Writing 4, 7; FACS 16)~~

10) Summarize the main elements of a promotional mix and examine promotional activities specific to the fashion design industry. Develop and implement a promotional campaign to strategically position and publicize the fashion line. Produce and deliver a technology-enhanced presentation

of the promotional plan for the fashion collection that could be translated into a runway fashion show. (TN Reading 2; TN Writing 4, 6; FACS 16)

Career Portfolio

11) Compile important artifacts that represent professional skills and personal style to create a professional portfolio and accompanying electronic representation. Develop a plan to distribute the electronic portfolio as part of a career job search and/or as admission to a postsecondary design institution. (TN Reading 1, 8; TN Writing 4, 9; FACS 16)

Internship Option**

12) Participate in a work-based learning internship experience to develop, practice, and demonstrate skills outlined in standards above. Internship should follow current Tennessee work-based learning guidelines as appropriate.

13) Create and continually update a personal journal to document internship activities. Draw connections between the experience and course content, thoughtfully reflecting on:
   a. Acquired leadership and technical skills
   b. Problem-solving techniques and decision-making skills
   c. Team member participation in a learning environment
   d. Personal career development
   (TN Writing 2, 4)

14) Upon conclusion of the internship, write an informative essay summarizing the internship experience and next steps for personal and professional growth. Produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the internship. (TN Writing 2, 4, 6)

** Although a hands-on experience in work-based learning (WBL) is the most ideal, it is recognized that not all students will be able to be placed in a working establishment. If a student is placed, then the experience would follow the requirements of the state board's WBL Framework and the Department's WBL Policy Guide. For information, visit https://tn.gov/education/topic/work-based-learning.

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6 and 10 at the conclusion of the course.

- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Business and Marketing

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5905
Prerequisite(s):	None
Credit:	1
Grade Level:	9-10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business, Marketing, or Finance courses.
Programs of Study and Sequence:	This is the first course in the *Business Management, Health Services Administration, Accounting, Banking & Finance, Marketing Management,* and *Entrepreneurship* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Industry Certifications:	None
Dual Credit or Dual Enrollment:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsements:	030, 032, 035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Introduction to Business and Marketing is an introductory course designed to give students an overview of the Business Management and Administration, Marketing, and Finance career clusters. The course helps
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students prepare for the growing complexities of the business world by examining basic principles of business, marketing, and finance in addition to exploring key aspects of leadership, ethical and social responsibilities, and careers. Students' academic skills in communications, mathematics, and economics are reinforced with activities modeled in the context of business topics. Upon completion of this course, proficient students will be equipped with the foundational skills to succeed in any of the Business, Marketing, or Finance programs of study and will be prepared to make an informed decision regarding which pathways they would like to pursue in high school. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee Economics standards.*~~

Program of Study Application

This is the foundational course for all Business Management & Administration, Marketing, and Finance programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Business Management & Administration, Marketing, and Finance career cluster websites available here: https://tn.gov/education/topic/career-clusters.

Course Standards

Career Exploration of Business Management, Finance, and Marketing Careers

1) Explore careers in each of the Business Management & Administration, Finance, and Marketing pathways. For each of these career clusters, research the job descriptions and typical activities of major professions such as chief executive officer, accountant, real estate agent, advertising specialist, branch manager, wealth management/trust officer, and more. Produce a career pathways chart or other graphic detailing the aptitudes and training required for careers of interest. For example, outline the typical skills and training required to become a human relations manager, including personal aptitudes, postsecondary credentials, and licensing. Upon completion of the chart, conduct a self-assessment of aptitudes, interests, and personality aligned to careers; then devise a tentative career plan to reach employment goals based on the research conducted. ~~(TN Reading 1, 2, 3, 4, 7; TN Writing 2, 9)~~

2) Conduct a job market search for one of the careers selected in the preceding standard by browsing print and online job boards and vacancy announcements. Consider factors such as local industry needs, projected annual openings, and prospects for growth when researching specific occupations. Synthesize findings to create a report comparing three or more job openings within the selected career, based on the following criteria: (1) education/certification requirements, (2) recommended years of experience, (3) salary and benefits, and (4) expected roles and responsibilities outlined in the vacancy announcement. ~~(TN Reading 1, 4, 9; TN Writing 4, 7)~~

3) Research the management skills required of individuals in order to be productive members of society. Identify the specific skills related to time management, organizational planning, teamwork, and professionalism necessary for success in the workplace.

4) Research the development of self-esteem and self-image in individuals. Create a list of factors that promote and hinder the development of positive self-esteem and self-image. Formulate a plan to build/improve self-esteem in a class project or school based project. ~~(TN Reading 2, 5)~~

5) Compare and contrast skills for communicating professionally in business as well as informally in everyday social interactions. Differentiate between verbal and nonverbal communication. List specific techniques for effective communication and evaluate how different cultures attach different meanings to communication techniques. (TN Reading 4, 9; TN Writing 4)

Business Concepts and Operations

6) Define the term *business*, and research the four major functions of business: (1) production and procurement, (2) marketing, (3) management, and (4) finance and accounting. As part of a short research project and presentation, select a product and trace its development through each of the four functions, detailing who is involved at each stage. For example, deliver a presentation explaining how the iPhone goes from raw materials to final packaged product available for sale. (TN Reading 2, 4; TN Writing 8)

7) Identify the factors of production (i.e., natural, labor, capital, and entrepreneurial). Drawing on case studies, textbooks, or similar resources, discuss the concept of opportunity cost in the context of business operations, and explain how businesses make decisions based on scarcity of resources. (TN Reading 1, 2, 4)

8) Summarize the foundational economic principles of supply and demand. Distinguish between an economic good and an economic service, and draw conclusions about how the law of supply and demand influences what goods and services businesses will produce using limited resources. Using a range of goods and services as evidence, write a brief informative text illustrating this relationship and the implications for consumers and the economy at large. (TN Reading 1, 2, 4; TN Writing 2, 4)

9) Research and describe the four stages of a business cycle (recession, depression, recovery, and peak). Using a graphic organizer, label each stage of the business cycle and plot the generally accepted economic activities occurring at each stage. (TN Reading 1, 2, 4; TN Writing 4, 6)

10) Compare and contrast the three primary types of business ownership: sole proprietorship, partnership, and corporation. Research a local business in the community and compile a profile detailing the type of ownership, history and background of founding, and description of products or services offered. In an informative narrative, highlight any changes the business has made to its operations in response to market and population shifts, infrastructure development (i.e., interstates, public transportation), inventions, expansion opportunities, and other market factors. (TN Reading 2; TN Writing 2, 7)

11) Drawing on resources such as the Tennessee Department of Labor and Workforce Development, the Tennessee Department of Economic and Community Development, and local Chambers of Commerce or Development Districts, investigate the current economic situation in the county and compare it to the economic situation of the state. Write a report on the findings, citing evidence from sources researched. Findings can include the unemployment rate, business growth/decline, occupation growth/decline, population changes, government operating budget, etc. Include an analysis on how economic conditions affect employment and product consumption, and draw conclusions about the implications of such conditions on the creation, expansion, and relocation of businesses. (TN Reading 4, 7; TN Writing 2, 4, 7; TN Math N-Q, S-ID)

12) Draw on a range of print and digital sources, such as articles, videos, and textbooks, to create a timeline or similar narrative detailing the evolution of business in the U.S. Annotate the timeline to explain the impact that various technological innovations (e.g., the steam engine, sewing machine, assembly line, telephone, automobile, computer, internet) have had on consumer buying behavior over time. For example, the invention of the sewing machine created mass production and surplus of goods requiring advertising. Formulate a written argument concerning how emerging technologies continue to transform business and present new challenges and opportunities to business owners. (TN Reading 1, 2, 7; TN Writing 1; TN Economics 5)

13) Cite the advantages and disadvantages of a market economy, a command economy, and a mixed economy. Discuss the relationships between consumers, business, and government in various economic systems, and analyze differences in the rights and responsibilities of these actors in countries where these distinctive systems exist. (TN Reading 1, 2; TN Writing 2; TN Economics 1)

14) Explain the purpose of a business plan, and list the four major parts typically included (business description, management plan, marketing plan, and financial plan). Describe the importance of developing a business plan when seeking out potential investors or lenders. In preparation for a future career as an owner or entrepreneur, develop an original business philosophy detailing one's beliefs for how a business should be run. (TN Reading 1, 4; TN Writing 4, 9)

Financial Concepts

15) Define and furnish examples of foundational financial concepts and terminology, including but not limited to financial statements, revenue, expenses, assets, liabilities, equity, net worth, profit, and net loss. Demonstrate financial literacy and quantitative reasoning when discussing these concepts in the context of business operations (for example, when interpreting a business's financial plan). Apply basic numeracy skills to understand financial phenomena such as interest and savings. (TN Reading 1, 4, 5, 7; TN Math N-Q)

16) Differentiate between fixed and variable expenses on a business's balance sheet. Select three of the expenses listed, draw conclusions as to their importance to the business, and analyze cost-cutting strategies a company might take to minimize expenses in each of the chosen categories. (TN Reading 1, 4, 5; TN Writing 4; TN Math N-Q)

17) Prepare a mock purchase order, invoice, and/or sales receipt (including shipping and taxes) for a sample product/package. Explain the elements that comprise the financial document and be able to identify any mistakes and miscalculations in order to assist a mock client. (TN Reading 1, 3, 4, 7; TN Writing 4, 6; TN Math N-Q)

18) Plan a budget for an upcoming community service project or career and technical student organization (CTSO) event. Create a comprehensive budget narrative to accompany the budget, including both a written statement and a summary worksheet listing all expenses, justifying each cost with evidence for why it is needed to successfully complete the project. Detail estimated and actual costs as well as differences in cost in terms of dollars and percentages. (TN Reading 1; TN Writing 4; TN Math N-Q)

Marketing Concepts

19) Define the term *marketing*, and describe the seven functions of marketing (distribution, financing, marketing information management, pricing, product/service management, promotion, and selling). Citing examples of prominent or local companies' marketing campaigns, argue for the importance of marketing as part of a business's strategy to increase revenue. (TN Reading 1, 4; TN Writing 1)

20) Describe the components of the marketing mix (i.e., price, product, promotion, and place). Investigate the launch of a new product or service; research how the company employed the marketing mix to aid in the launch; then create a presentation highlighting successes, challenges, and lessons learned. Additionally, critique the company's strategies and suggest alternative ideas for future campaigns, following the principles of the marketing mix. (TN Reading 1, 9; TN Writing 2, 4, 9)

21) Define advertising and list types of media that business use to reach potential customers. Analyze sample advertisements, describe the purpose of the ads, and evaluate the decision regarding which medium (TV, radio, social media, billboard, magazine, newspaper, or other) was chosen in terms of market reach. (TN Reading 4, 5, 6; TN Writing 4, 9)

22) Define marketing research and explain the importance of marketing research in making business decisions. Conduct a short research project following the basic marketing research process: (1) define the problem to be researched, (2) design a survey instrument, (3) collect and tabulate data, (4) interpret findings, and (5) make recommendations for solving the identified problem. Draw on data generated from the survey to supply evidence for the proposed recommendations; demonstrate the ability to use and manipulate pivot tables to illustrate different ways of presenting and grouping data. Prepare a chart to be utilized in a mock marketing management meeting, displaying data in a graphic format based on one or more of the tables, and present as evidence alongside recommendations. Example projects include determining the demand for an expanded school lunch menu, or gauging interest in the development of a new neighborhood park. (TN Reading 2; TN Writing 4, 7; TN Math N-Q, S-ID)

Social Responsibility and Ethics

23) Research the concept of social responsibility and ethics as important components of business. Develop a hypothesis for why businesses must increasingly consider their impact on society when making decisions. Then, attend a local business-sponsored community event or explore case studies illustrating the social responsibilities of today's businesses. Write a reflection paper summarizing observations; specifically, evaluate how businesses benefit from engaging in responsible business practices, including benefits to the community, the environment, the marketplace, and the business/workplace itself. (TN Reading 8; TN Writing 2, 4, 8)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Statistics and Probability.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.
    - Note: The standards in this course are not meant to teach economics concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with economics educators to design project based activities or collaborate on lesson planning.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Business Communications

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5888
Prerequisite(s):	*Introduction to Business & Marketing* (5905)
Credit:	1
Grade Level:	10 - 11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business courses.
Programs of Study and Sequence:	This is the second course in the *Business Management* and *Office Management* programs of study.
Aligned Student Organization(s):	DECA: http://ww.decatn.org; FBLA: http://ww.fbla.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	030, 031, 032, 034, 037, 039, 041, 052, 054, 055, 056, 057, 152, 153, 158,201, 202, 203, 204, 311, 430, 432, 433, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Business Communications is a course designed to develop students' effective oral and electronic business communications skills. This course develops skills in multiple methods of communications, including social media, as well as electronic publishing, design, layout, composition, and video conferencing. Upon completion of this course, proficient students will be able to demonstrate successful

Approved April 10, 2015; Amended April 15, 2016

styles and methods for professional business communications using the proper tools to deliver effective publications and presentations. ~~Standards in this course are aligned with the Tennessee State Standards in English Language Arts and Literacy in Technical Subjects.*~~

Program of Study Application

This is the second course in the *Business Management* and *Office Management* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Business Management and Administration website at https://tn.gov/education/article/cte-cluster-business-management-administration.

Course Standards

Communication Components

1) Demonstrate compliance with the school's ethics policy regarding copyrighted materials, plagiarism, authenticity, proper citations, privacy, and proper use of technology resources. ~~(TN Reading 3)~~

2) Identify, analyze, and critique the basic components of communications, such as the message, the sender, the receiver, the mode, the noise, and the response. This includes conducting responsible research when necessary, developing effective arguments, composing meaningful and coherent messages appropriate to the intended audience, and polishing one's delivery skills to deliver an effective and credible message, followed by listening. ~~(TN Reading 1, 2, 5, 6; TN Writing 4, 5, 8, 9)~~

3) Differentiate between verbal and nonverbal communications when interacting with peers, subordinates, superiors, and customers. List specific techniques for effective communications and evaluate how different cultures and generations attach different meanings to various gestures, intonations, and other communications techniques. ~~(TN Reading 4; TN Writing 9)~~

4) Practice and implement proven communication techniques to foster positive interpersonal relationships in the business atmosphere, such as:
   a. Establishing and maintaining positive relationships with coworkers and customers (e.g., being fair, helpful, tactful, gracious, and appreciative).
   b. Recognize manifestations of tension, and employ recommended strategies to resolve the situation in the most favorable ways (e.g., collaborating, compromising, accommodating).
   c. Practice various interactions and conflict resolution strategies by participating in role-play exercises and structured controversies, allowing students to model positive/supportive behaviors that respect varying perspectives and viewpoints of others and yield consensus decision-making.
   ~~(TN Reading 1, 8; TN Writing 2, 8)~~

Digital Citizenship

5) Create a rubric for evaluating and selecting the best electronic communication tool for a given task or situation. Using scenarios from business and industry, identify appropriate tools for various situations and defend selections through a persuasive narrative, based on the application of the rubric. (TN Reading 1, 8; TN Writing 1, 4)

6) Research and analyze various aspects of good digital citizenship. In groups, discuss the effects of technology on day-to-day and business communications. Select one topic (such as hacking of a customer database, social media, etc.) for further exploration and develop an electronic presentation employing to demonstrate the implications of the topic on society, as well as business and industry. (TN Reading 1, 2; TN Writing 2, 4, 5, 6, 8)

7) Compile significant points regarding courtesy and propriety in a digital business world ("netiquette") and prepare a presentation or web page that includes the topics of
   a. Message priority (urgent, normal, or low)
   b. Consent to share (property rights)
   c. Confidential or sensitive information (privacy)
   d. Message formatting (fonts, color, case, informal abbreviations, emoticons)
   (TN Reading 1; TN Writing 2, 4, 5, 6)

Business Writing

8) Evaluate, create, and revise business correspondence, short contracts and reports, electronic forms, and small legal documents for a business in standard English using the following:
   a. Employing word processing and simple spreadsheet programs
   b. Using proper grammar essentials, including parts of speech, vocabulary, punctuation, sentence structure
   c. Applying accepted business styles, including fonts, margins, layout, color, formats for dates, times, currencies, proper names
   d. Using acceptable business language, vocabulary, acronyms
   e. Writing for social media
   f. Writing for the internet
   (TN Reading 1, 6; TN Writing 2, 4, 5, 6)

9) Analyze examples of writing for evolving digital platforms such as social media applications. Compare and contrast writing conventions required for commonly used applications and construct an event announcement for a local business in formats appropriate for at least three different social media/networking tools. (TN Reading 1, 2, 7, 9; TN Writing 4, 5, 6)

10) Locate a website used by a business to sell a product or service. Evaluate the website's design, content, text, images, layout, and color. Discern the site's effectiveness and ease of navigation, including the use of hyperlinks. Using persuasive writing, produce a critique addressing the pros and cons of the site, and offer recommended revisions. (TN Reading 2, 4, 7; TN Writing 1, 4, 6)

Desktop Publishing

11) Create, adjust, and publish business document projects to typographic standards:
   a. Using word processing or desktop-publishing software
   b. Planning layouts based on estimation and calculations to achieve accepted balance of text, art, photos, and white space
   c. Applying consistent style standards, including fonts, margins, layout, color scheme, and image and text formats
   d. Inserting and formatting merged graphic elements, such as charts, photos and artwork, and text embellishments
   e. Incorporating editing and revision markings to incorporate desired changes by the author/editor
   (TN Reading 3, 4; TN Writing 6)

12) Configure and send typographic output for designing camera ready documents on destination printer, color model (RGB, CMYK, etc.), preprint color requirement, and process color separations. (TN Reading 3, 4; TN Writing 2, 4, 6)

13) Manipulate, enhance and produce digital photographs, graphics, or other art elements utilizing photographic and / or graphic editing software. (TN Writing 6)

Oral Communications

14) Draft and edit two speeches: (1) to persuade, and (2) to inform. Incorporate planning and preparation to deliver speeches that adhere to the following expectations:
   a. Appropriate for various audiences and purposes
   b. Delivered with enthusiasm and appropriate body language
   c. Structured to guide the listener to the desired objective or response
   d. Includes facts and research, in addition to original claim(s) and counterclaim(s) supported by evidence
   e. Revised based on peer feedback
   (TN Reading 1, 2; TN Writing 4)

15) Critique the purpose of various speaking assignments to identify the design and goal, such as to inform, educate, convince, persuade, or lead to action. (TN Reading 1, 2, 6; TN Writing 2, 7)

16) Plan, prepare, and conduct a short business meeting, including following-up after the meeting. Write an agenda, develop and produce necessary materials, facilitate the meeting effectively, and prepare a follow-up email thanking the attendees for their participation and summarizing key takeaways and action items. (TN Reading 2; TN Writing 4, 6, 7, 8)

17) Promote, organize, and practice creative problem-solving using the brainstorming approach, incorporating common techniques such as predefined time limits, short breaks, goals, visual aids, and record-keeping.

Virtual Meetings

18) Plan, organize, schedule, and deliver a webinar to one or more distant parties using computer conferencing tools (e.g., telephone or voice over IP, online conferencing system).
   a. Prepare an invitation, agenda, and overall script for the webinar, outlining the planned verbiage and business-related flow of information. Include guidelines, minutes and follow-up.
   b. Single-handedly or as a team, conduct the webinar or simulated webinar according to the agenda.
   c. Leverage the video, audio, and meeting enhancement tools available through the selected webinar software, such as highlighting, chat, polling, and question features to maximize audience interaction.
   d. Save, and edit, if needed, a short audio/video recording of the webinar for later publication.
   (TN Reading 3, 6; TN Writing 4, 6)

19) Plan, organize, schedule, and conduct a web videoconference or simulation with one or more distant parties using computer conferencing tools (e.g., webcams, high-speed Internet, computer)
   a. Prepare an overall agenda for the web conference, outlining the planned exchanges of information, positioning and appearance of people, and switching between video sources (e.g., webcams, document cams, and other imagery).
   b. Follow the agenda to complete the web-meeting exchange, either single-handedly or as part of a team.
   c. Use effective communication and engagement strategies (such as effective meetings facilitation) to encourage active participation by all parties connected to the meeting.
   d. Save, and edit if needed, a short audio/video recording of the web meeting for later publication.
   (TN Reading 3, 6; TN Writing 4, 6)

Career Activities

20) Prepare an electronic portfolio
   a. Including work products demonstrating career preparation skills, using an assortment of media (text, photos, video, hyper-linked pages).
   b. Including a professionally formatted résumé and other supporting documents such as cover letter and application.
   c. Packaged on a suitable media (e.g., CD, DVD, memory stick, web site).
   (TN Writing 4, 5, 6)

21) Conduct a job search of positions in one or more career areas of interest using tools such as https://www.jobs4tn.gov and other online employment resources; complete a job application; participate in mock interviews with partner businesses and/or through participation in a student organization event. (TN Reading 3; TN Writing 4)

22) Address the appropriate use of and ethics related to social media in personal and professional situations and its impact on career search processes, as well as its impact on the professional reputation of a person. (TN Reading 1, 2)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Business Management

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5889
Prerequisite(s):	*Introduction to Business & Marketing* (5905)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business courses.
Programs of Study and Sequence:	This is the third course in the *Business Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning .
Available Industry Certifications	None
Dual Credit or Dual Enrollment	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to a local postsecondary institution(s) for more information.
Teacher Endorsements	030, 035, 039, 052, 054, 056, 057, 152, 153, 158, 201, 202, 204, 311, 430, 433, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Business Management focuses on the development of the planning, organizing, leading, and controlling functions required for the production and delivery of goods and services. This applied knowledge course addresses the management role of utilizing the businesses' resources of employees, equipment, and

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capital to achieve an organization's goals. Students will participate in a continuing project throughout the course in which, individually or in teams, they will present recommendations to improve an existing business. Local business partnerships are encouraged to provide resources for faculty and students. Upon completion of this course, proficient students will be able to complete a full review of an existing business and offer recommendations for improvement as would a management consultant. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, as well as Tennessee Economic standards.*~~

Program of Study Application

This is a capstone course in the *Business Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Business Management & Administration website at https://tn.gov/education/article/cte-cluster-business-management-administration.

Course Standards

Role of Management

1) Describe the management process and examine the functions of management (planning, organizing, leading, and controlling). Through review of case studies or news media, illustrate how concerns for the environment, an increasingly diverse workforce, globalization of the marketplace, and rapidly changing technology have impacted how businesses apply these functions. ~~(TN Reading 1, 2, 4; TN Economics 1)~~

2) Summarize characteristics of, and distinguish between, different management theories (such as scientific management, Total Quality Management (TQM), Ouchi's Theory Z, Six Sigma, etc.). Drawing on information from research, illustrate how economic, political, or cultural decisions influence management theories that have been applied in the business environment. For example, hypothesize how Maslow's Hierarchy of Needs affects theories of management. ~~(TN Reading 1, 2, 4, 6; TN Writing 2, 4, 7, 9; TN Economics 2)~~

3) Research the management skills needed in today's business environment (such as goal setting, decision making, communications, delegation, technical skills, motivational and leadership skills). Through the analysis of case studies, discuss the role of business leaders who have been recognized for their influence on modern managerial approaches (such as Theory Z's William Ouchi, General Electric's Jack Welch, Hewlett-Packard's Carleton Fiorina, or Facebook's Sheryl Sandberg). Synthesize research to produce a profile of a strong candidate for a business manager, citing specific evidence from text. ~~(TN Reading 1, 2; TN Writing 2, 4, 7, 9)~~

Planning and Strategic Management

4) Analyze the elements of sample business plans or business plan templates found in informational text, identifying and describing the purpose of common elements. Discriminate between elements that govern culture (such as vision, mission, core priorities and social responsibility) and those that may govern operational goals (such as market share, profitability, and product development). ~~(TN Reading 1, 6, 9; TN Writing 7)~~

5) Investigate and choose an existing business to research (individually or in teams) throughout the duration of the course. Describe the business' current target market, primary products or services offered, unique characteristics, current market position, and customer volume by summarizing available public documents about the business. (TN Reading 2, 7, 9; TN Writing 2, 4, 7, 8, 9)

6) Design, write, modify and evaluate a business plan for the identified existing business. The business plan should include, but may not be limited to, detailed descriptions of products and/or services offered, risk analysis, short and long term profits, marketing plan, investment needed to start and maintain the business, plans to obtain working capital, legal licenses, and vendor contracts. Include a company organization chart, job description and skills needed of main employees, physical equipment and facilities required, and any future expansion plans. (TN Reading 2, 4, 7, 9; TN Writing 4, 5, 6, 7, 9)

7) Study benchmark indicators included in a SWOT (Strength, Weaknesses, Opportunities, and Threats) analysis and conduct a SWOT analysis of the selected business using data and evidence collected from personal interviews, observations, print articles, and internet searches. Citing specific data and evidence, make a claim about the business' most significant weakness(es), or area(s) of opportunity, to address throughout the duration of the course. (TN Reading 1, 9; TN Writing 1, 4, 7, 9)

Business Process Considerations

8) Create a new, or recommend updates to an existing, mission statement for the selected business by summarizing information gleaned from personal interviews, observations, print articles, and internet searches about the specific aspirations, beliefs, and values of the company. (TN Reading 6; TN Writing 4)

9) Conduct a PEST analysis (Political issues, Economic factors, Socia-cultural factors, Technology) of the selected business, including available geographic, demographic and economic data gathered from multiple authoritative sources. Based on the analysis, make a prediction about necessary factors which need to be considered in order to accurately address the businesses' most significant weakness(es) or area(s) of opportunity selected in standards 6. (TN Reading 1, 4, 6; TN Writing 4, 7, 9)

Marketing Considerations

10) Identify up to five businesses that could be considered competitors of the selected business. Gather and summarize information about the competition succinctly in a chart, table, or graphic. Information may include variety of products available, location, prices, services, and other unique characteristics. (TN Reading 1, 2, 7, 9; TN Writing 6, 7)

11) Make a claim about the current target market of the selected business, developing and supporting the claim and counterclaim(s) with data and evidence provided by the business and from research on potential competitors. Develop a detailed customer profile to summarize characteristics, including the BPI (Buying Power Index), for the target market. (TN Reading 1, 4; TN Writing 1, 4, 6, 7)

12) Using previous research on the selected business and its competitors, describe typical prices in the industry for similar products or services, noting how the prices of the selected business compare to others. Summarize how businesses make and review pricing decisions based on four key market factors: cost and expenses, supply and demand, consumer perception, and competition. Analyze each factor for the selected business and summarize how each relates to typical organizational goals of earning a profit, gaining market share, and being competitive, noting where there are chances to address weakness(es) or capitalize on area(s) of opportunity identified in standard 6. (TN Reading 2, 4, 5, 9; TN Writing 2, 4; TN Economics 1, 2; TN Math N-Q)

Organizational Considerations

13) Describe advantages and disadvantages of the basic forms of business ownership (sole proprietorship, partnership, and corporation) and identify variations of basic forms of business ownership (franchise, limited partnership, cooperative, limited liability company, and S corporation). Determine which ownership structure is employed by the selected business and hypothesize why it was selected. Review copies of available partnership agreements, articles of incorporation or franchise contracts, noting characteristics important for successful operation of a given business. (TN Reading 1, 4; TN Writing 4, 9)

14) Document existing operations plan of the selected business, describing location, hours of operation, customer accessibility, equipment, storage, and inventory needs, and current supply chain elements. Reviewing the most significant weakness(es), or largest area(s) of opportunity for the selected business determined in standards 6, make recommendations about changes to current plan to improve business operations. For example, recommending a new location to improve customer foot traffic. (TN Reading 1, 2, 4; TN Writing 4; TN Economics 3)

15) Diagram and describe the organizational structure of the business by creating an organizational chart of existing positions and/or department in the business, paying close attention to documentation of job descriptions (including reporting structures), accurate number of employees, and any outsourced labor. (TN Writing 4, 5, 6)

16) Identify applicable risks to the selected business (such as fire or flood damage or significant theft of inventory) and research available options for risk management, such as insurance. Make a claim about appropriate risk management strategies to employ to address the businesses' weakness(es) or area(s) of opportunity identified in standard 6, justifying claim with data and evidence from research. (TN Writing 1, 4, 9)

17) Identify and list appropriate national, state, and local bodies governing the operations of the selected business. Review documentation to summarize federal, state, and local regulations and laws (such as environmental regulations, zoning or licensing requirements, and legal stipulations) that are necessary for the continued operations of the selected business. (TN Reading 2, 4; TN Economics 3)

18) Analyze the essential parts of a contract by reviewing sample contracts and researching the Uniform Commercial Code for basic commercial law. Request a copy of a contract in use at the

selected business and review it to recommend potential areas for refinement or improvement. (TN Reading 1, 5)

Human Relations Considerations

19) Create a new, or recommend updates to an existing, employee manual for the selected business by summarizing information gleaned from personal interviews, observations, print articles, and internet searches about the human resource policies and employee expectations of the company. Include the following:
    a. procedures for employee hiring and release
    b. orientation of new employees
    c. performance assessments
    d. handling grievances
    e. compensation packages

    (TN Reading 9; TN Writing 2, 4, 7, 9)

20) Describe legal strategies used by labor and management (strikes, boycotts, layoffs, and lockouts) and illegal strategies used by labor and management (wildcat strikes, secondary boycotts, and preventing workers from forming unions). Conduct current event research highlighting recent activities involving labor and management disputes, drawing conclusions about the potential impacts of a labor and management strategy on the selected business, if any. (TN Reading 4; TN Writing 7)

Financial Considerations

21) Interpret the data shown on financial statements (income statement, balance sheet, cash flow statement, and statement of net worth) of the selected business. Benchmark the business' financial position against others in the industry, by reviewing available public filing documents such as financial statements, annual reports, and statements to shareholders of national firms. (TN Reading 1, 4, 7; TN Writing 4, 7; TN Math N-Q)

22) Evaluate various financial control tools such as budgets, audits, and financial ratios. Construct a TQM operations cost controlling matrix that includes costs, inventory tracking levels, and turnover rates of the selected business. Identify potential areas of improvement, especially as they relate to the identified weakness(es) and area(s) of opportunities outlined in standard 6. (TN Reading 3; TN Writing 4, 6; TN Math N-Q)

23) Assess the short-term and long-term financial needs of the selected business, attending to details about the current ownership structure. Evaluate advantages and disadvantages of additional funding through equity capital versus debt capital, noting where potential influx of funding may impact current ownership structure. (TN Reading 4; TN Writing 1, 4, 7; TN Math N-Q)

24) Analyze the importance of international trade as it relates to small businesses and corporations. Research reasons a company might choose to enter a foreign market, examine cross-cultural communication marketing challenges, the laws and import regulations that

govern international trade, and prepare a presentation on how the business could succeed in an international environment. ~~(TN Reading 2, 4; Writing 4, 7, 9)~~

Final Project

25) As would a management consultant, compile a set of recommendations for the selected business based on the research completed in standards 7-24 to address one or more of the following: streamlining operations, increasing profitability and competitiveness, meeting long-term funding needs, or addressing employee concerns in order to ultimately attend to the weakness(es) and/or area(s) of opportunity identified in standard 6. Plan, revise, edit, and rewrite recommendations throughout the course to ensure focus on what is most significant for a given audience. Present recommendations through both a formal, written report and an oral presentation, including appropriate financial calculations, charts and graphs, and citations for relevant sources. ~~(TN Reading 1, 2, 5, 6, 7, 8, 9; TN Writing 1, 4, 5, 6, 7, 8, 9)~~

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.~~
  - ~~Note: The standards in this course are not meant to teach economics concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with economics educators to design project based activities or collaborate on lesson planning.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number, Quantity, Functions.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning]

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Business & Entrepreneurship Practicum

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	6159
Prerequisite(s):	Two credits in a Business or Marketing program of study
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business or Marketing courses.
Programs of Study and Sequence:	This is a capstone course in the *Business Management, Health Services Administration,* and *Entrepreneurship* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	030, 035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Business & Entrepreneurship Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous Business and Marketing courses within a simulated startup environment or authentic business setting. The course is structured to allow

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students the creativity to develop, launch, and market original business ideas. It is ideal for students who wish to pursue careers as future business owners or entrepreneurs. Practicum activities can take place around student-led startups under the supervision of the instructor, or in collaboration with a local business incubator. The standards in this course can also be used to promote student participation in a work-based learning (WBL) experience through an internship or other off-campus arrangement. Upon completion of the practicum, proficient students will be prepared to further develop their business ideas into viable ventures, or continue their study at the postsecondary level. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the capstone course in the *Business Management, Health Services Administration,* and *Entrepreneurship* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the please visit the Business Management & Administration, Marketing, and Finance career cluster websites available at https://tn.gov/education/topic/career-clusters.

Course Standards

Launching a Career in Business

1) Research a small business or business venture in an industry/market/location of choice, including but not limited to the local region. Produce an in-depth profile, case study, or similar analysis of the chosen company. Companies could range from local businesses to web startups to expansions of existing businesses into new products or markets. Cite specific textual evidence from the company's literature, conduct interviews, and/or analyze press coverage (if available) to summarize the following:
   a. The mission and history of the organization
   b. Headquarters and organizational structure
   c. Products or services provided
   d. Marketing/branding strategy
   e. Profit model
   f. Website and contact information
   ~~(TN Reading 1, 2; TN Writing 7)~~

2) Complete an authentic job application as part of a career search or work-based learning experience. Participate in a mock interview. Prior to the interview, update a personal resume, research tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedure. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. ~~(TN Reading 2; TN Writing 2, 4, 7, 9)~~

3) Investigate the current climate for entrepreneurship and business acquisition in the U.S. and abroad. Synthesizing the most recent information on interest rates, consumer spending, market competition, regulation, investment activity, and other economic data, identify the potential constraints and opportunities for starting a business in a selected market of interest. Draw conclusions based on the research and compile into a memo, executive summary, or mock proposal highlighting where to compete, how much to invest, and which consumers to target. ~~(TN Reading 9; TN Writing 2, 4, 7, 8, 9)~~

Market Research

4) Independently or in teams, conduct a market research project to determine the viability of an original business idea or the recommendations to improve the marketing activities of an existing business.. Demonstrate the ability to design simple surveys, retrieve secondary data from print and online sources, tabulate results, write analyses, and make decisions based on evidence. If possible, consult or collaborate with local area professionals to determine the viability of original business ideas. Compile findings and future directions in a professional print or online document. ~~(TN Reading 7, 8, 9; TN Writing 2, 4, 6, 7)~~

Business Proposal

5) Building on standards from *Entrepreneurship* and *Business Management*, individually or in teams, develop a new or modify an existing business plan for the proposed startup/business venture. Include at minimum the following components:
    a. Executive summary
    b. Business description
    c. Plan of operations, including human capital considerations
    d. Industry analysis
    e. Competitor analysis
    f. Marketing plan
    g. Financial plan
    h. Any relevant appendices, cover sheets, letters of support, or references
   Compile the business plan in a print or online format that could be shared with potential funders, partners, or other stakeholders. ~~(TN Writing 2, 4, 6)~~

6) In preparation for the launch of the new business/venture, identify potential mentors and sources of support in the community (both financial and in-kind services), such as clients, customers, funders, grant-making entities, or community organizations. Practice pitching the business idea to mentors and various audiences. Seek feedback and recommendations on presentation and proposal details. Analyze the feedback and recommendations to justify any

changes to the business plan, citing evidence from the initial presentation. Upon revision, revise the business plan, documenting all changes made. (TN Writing 5, 6, 9)

7) Based on the research and revisions conducted in the previous standard, develop and deliver a formal presentation as part of a bid for startup capital, investors, or public backing. The presentation could be delivered in a variety of formats depending on capacity and constraints: for example, as an in-person pitch before an audience of potential funders; or as a video recording uploaded to a website such as Kickstarter. Self-reflect on initial success based on feedback from the audience or pledges of support, depending on approach. (TN Writing 4)

8) As a supplement to the formal presentation, conduct a preliminary break-even/profit-loss analysis for the first year of the startup's operations or a business acquisition. Determine the long-term financial goals of the company; make projections for 1, 5, and 10 years ahead. Drawing on knowledge and skills learned in previous courses, design metrics for tracking financial goals and develop an internal reporting system for monitoring progress. (TN Reading 1, 4, 7, 9; TN Writing 4, 6, 9; TN Math N-Q)

9) Expanding on the marketing strategy drafted in the revised business plan, conduct the necessary analysis (i.e., produce a target customer profile, release a survey, etc.) and implement the marketing strategy in line with plan goals. Seek avenues for increasing product/service visibility, such as promoting the company on social media, partnering with another business in a promotional tie-in or cross-selling activity, sponsoring a non-profit event or offering incentives such as samples, games prizes, and loyalty programs..

10) Critique the business plan of another team or classmate, annotating the plan with recommendations and suggested edits. Cite specific examples in the text to support recommendations. (TN Reading 1, 2, 3, 4, 5, 6, 7, 8)

Professional Ethics and Legal Responsibilities

11) Reflect on potential ethical and legal challenges associated with the proposed business idea. For example, for a hypothetical clothing line startup that intends to source materials from overseas, determine how the company will ensure that labor laws are followed at all points along the supply chain. Examine a variety of perspectives surrounding the issue(s) then develop an original analysis explaining the impact of the issue on those involved, using persuasive language and citing evidence from the research. Other potential issues include copyright infringement, customer privacy and data usage concerns, and safety of employees and consumers. (TN Reading 1, 2, 6; TN Writing 1, 4, 7, 8)

Portfolio

12) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the entrepreneurial or business acquisition process. The following documents will reside in the student's portfolio:
    a. Career and professional development plan

    b. Resume

    c. List of responsibilities undertaken through the course

    d. Examples of business plan and supporting materials developed and used during the course

    e. Sources of support, including mentors, financial, in-kind, and other

    f. Description of technology used, with examples if appropriate

    g. Periodic journal entries reflecting on tasks and activities

    h. Feedback from instructor and/or supervisor based on observations

~~(TN Reading 7; TN Writing 4)~~

Communication of Project Results

13) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as sample survey results, excerpts from the business plan or market data on the target users. Prepare the presentation in a format that could be presented to both a business and a lay audience. Seek opportunities to submit the business plan and/or presentation to local or national contests, career and technical student organization (CTSO) competitive events, or other opportunities to increase the potential for success of the business idea. ~~(TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)~~

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Computer Applications

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5891
Prerequisite(s):	None
Credit:	1
Grade Level:	8-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Business courses.
Programs of Study and Sequence:	This is the first course in the *Office Management* program of study.
Aligned Student Organization(s):	DECA: http://ww.decatn.org; FBLA: http://ww.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning .
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	Some local dual enrollment/dual credit opportunities exist. Please check with the local college of applied technology or community college for options.
Teacher Endorsement(s):	030, 033, 037, 039, 041, 052, 054, 055, 057, 152, 153, 158, 201, 202, 203,204, 311, 430, 431, 432, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Computer Applications is a foundational course intended to teach students the computing fundamentals and concepts involved in the use of common software applications. Upon completion of this course, students will gain basic proficiency in word processing, spreadsheets, databases, and presentations. In addition, students will have engaged in key critical thinking skills and will have practiced ethical and appropriate behavior required for the responsible use of technology. Standards in this course are

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the foundational course for the *Office Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Business Management and Administration website at https://tn.gov/education/article/cte-cluster-business-management-administration .

Course Standards

Communication Networks, the Internet, and Technology Operations

1) Research recent developments in information technology affecting the supply/demand characteristics of the job market, including career pathways and occupational outlooks for occupations in business and finance that require information technology expertise. Synthesize findings into a presentation highlighting the typical roles and responsibilities of professionals in high-growth occupations. (TN Reading 1, 2, 7, 9; TN Writing 4, 6, 7, 8, 9)

2) Identify, connect, and demonstrate the correct usage of elements of a typical home computer, including a monitor, keyboard, mouse, network cable, and USB devices (such as camera, memory, or scanner). Perform basic troubleshooting as needed for situations involving these components (e.g., if the computer does not recognize a device). (TN Reading 3, 4)

3) Correctly and safely execute basic file management operations on a typical personal computer and shared storage media, including the opening, creating, copying, moving, deleting, and renaming of files and folders, as well as searching for a specified file or folder on local or networked storage media. (TN Reading 3)

4) Describe and demonstrate the correct connections and setup for a new wireless router in a home computing environment. Discuss the impact of network speeds, wireless communication, firewalls, and gateways on individual and societal productivity. (TN Reading 3, 4)

5) Describe the steps necessary to retrieve, download, and safely install new applications, updates, and plug-ins from the Internet. (TN Reading 3)

6) Compare and contrast the accessibility of the Internet through a home router versus through a public wi-fi access point. Discuss the risks and advantages of using secure home networks versus publicly accessible networks. (TN Reading 1, 4, 8, 9)

7) While preparing materials and assignments in this course, use a browser to access and download Internet resources by uniform resource locator (URL), hyperlink, or favorite/bookmark.

Word Processing and Publishing

8) Use a word processing program to create and format documents with academic and business styles (e.g., memos, letters, agendas, reports, tabular lists) to communicate the results of research, meetings, lab reports, and relevant assignments in this course. (TN Reading 3, 7; TN Writing 2, 4, 6)

9) Craft documents using word processing program features and methods such as:
    a. Paragraph formatting (line spacing, justification, indentations)
    b. Bulleted and numbered lists
    c. Tables of multiple columns, with and without borders
    d. Margins, headers, footers, page numbers, and footnotes
    e. Typeface fonts and weights, including hyperlinks
    f. Capitalization, punctuation, number expression, grammar
    g. Printing orientation, one- or two-sided, to a selected printer
    h. Bibliographies and tables of contents
    i. Saving to a file that can be shared and/or transported, including saving to cloud-based or external sources
    (TN Reading 3, 4, 7; TN Writing 2, 4, 6)

10) Enhance documents by including graphic arts components such as borders and shaded elements, graphs and charts from other programs, watermarks, and imagery imported from technology devices and drives as well as sources retrieved from the Internet, including adding citations and/or captions for each element when appropriate. (TN Reading 3, 7; TN Writing 4, 5, 6)

11) Create, format, and edit documents suitable for print or electronic distribution, both four-color and two-color (black and white). (TN Reading 3; TN Writing 4, 5, 6)

12) Critique and edit existing documents with standard proofreading and editing marks to conform to a standard business style guide (e.g., fonts, colors, line spacing). Practice the use of electronic revision marks and comments, where supported. (TN Reading 1, 2, 5, 6, 8, 9; TN Writing 4, 5, 6)

13) Complete a comprehensive word-processing project with instructor approval that applies the skills acquired in this section. For example, prepare a contract, MLA-style report, business proposal, or budget report from a student organization. (TN Writing 4, 6, 7)

Spreadsheet Applications

14) Use a spreadsheet program to create and format academic and business documents for the purposes of tabulating and calculating numerical and/or textual data (e.g., statistics, historical data, measurements), such as budget calculations, sales reports, lab data, and related analyses. (Reading 1, 3, 4, 5, 7, 9; TN Writing 4, 6; TN Math N-Q, S-ID)

15) Craft documents using a spreadsheet program using features and methods such as:
    a. Cells, columns, and rows
    b. Formulas and functions

     c.   Copy, move, delete, and fill

     d.   Cell-value formats (numerical and text) and alignment

     e.   Column and row width/height, insert/delete, move

     f.   Printing to a selected printer

     g.   Saving with a file format that can be shared and/or transported

   ~~(TN Reading 3, 4, 5; TN Writing 4, 6; TN Math N-Q, S-ID)~~

16) Create new formulas to analyze data by calculating with, extracting from, presenting, and/or summarizing, including:

     a.   Basic arithmetic calculations

     b.   Basic mathematic (e.g., SUM, AVG, MIN, MAX) and text (e.g., LEN, LEFT, RIGHT, MID) functions

     c.   Copying formulas that include both relative and absolute cell references

     d.   Sorting in ascending/descending order

     e.   Filtering data to retrieve specific values

     f.   Basic conditional formatting (e.g., red for negative values)

   ~~(TN Reading 3, 4, 5; TN Writing 6; TN Math N-Q, S-ID)~~

17) Create and format for optimal clarity a variety of types of graphs and charts, including bar charts, line charts, pie charts, and X-Y graphs, based on tabulated data. ~~(TN Reading 3, 4, 7; Writing 4, 5, 6; TN Math N-Q, S-ID)~~

18) Retrieve a spreadsheet template (from those installed with the program or from the Internet) and customize it for a particular assignment approved by the instructor. For example, prepare a "timecard" of one's daily hours spent on a month-long job assignment. ~~(TN Writing 6)~~

Database Applications

19) Use a database program to interpret the structure of an existing database (found in teaching resources or teacher-created), identifying tables, fields, key fields, queries, forms, and reports. ~~(TN Reading 1, 3, 4, 5, 7)~~

20) Using an existing database (found in teaching resources or teacher-created), create and run a database report based on basic queries. For example, retrieve the relevant information to answer a customer product inquiry during a mock customer service phone call. ~~(TN Reading 3; TN Math N-Q, S-ID)~~

21) Using an existing database (found in teaching resources or teacher-created), create, modify, and perform basic queries through a form to create a new table/view in a database. ~~(TN Reading 3; TN Math N-Q, S-ID)~~

Presentation Software

22) Design, create, and deliver an oral presentation for a selected audience on a topic approved by the instructor. Using a specified slide number and duration, include the following elements:

     a.   A selected theme (colors, background, fonts, etc.)

     b.   Bulleted text based on a chosen style

     c.   Photographs and other imagery

      d.   Charts and graphs
      e.   Video and animated graphics
      f.   Animated transitions of slides and components within a slide

Save the file in a format that can be transported and shared with the audience. ~~(TN Writing 4, 6, 7)~~

23) Design, create, and deliver a self-running electronic slideshow for a selected audience on a topic approved by the instructor. Using a specified slide number and duration, include the following elements:
      a.   A selected theme (colors, background, fonts, etc.)
      b.   Photographs and other imagery
      c.   Video and animated graphics
      d.   Animated transitions of slides

Save the file in a format that can be transported and shared with the audience. ~~(TN Writing 4, 6, 7)~~

Digital Citizenship

24) Research, summarize, and deliver (via presentation, document, spreadsheet data/chart, or other format) a summary of the various perspectives and ramifications surrounding an ethical issue related to modern-day electronic communications, as approved by the instructor. Develop and strengthen claim(s) and counterclaim(s) about the issue, citing supportive evidence. Potential issues include spam, flaming, cyberbullying, libel, slandering, and mining of personal data for profit. ~~(TN Reading 1, 2; TN Writing 1, 4, 6, 7)~~

25) Research, summarize, and deliver (via presentation, document, spreadsheet data/chart, or other format) a summary of the various perspectives and ramifications surrounding an ethical issue related to intellectual property rights, as approved by the instructor. Develop and strengthen claim(s) and counterclaim(s) about the issue, citing supportive evidence. Potential issues include copyright infringement, piracy, plagiarism, art licensing, creative commons, and the state/federal laws that govern them. ~~(TN Reading 1, 2; TN Writing 1, 4, 6, 7)~~

26) Explain, furnish examples, and demonstrate technical literacy with the following terms:
      a.   The Internet, World Wide Web, and various browsers
      b.   Network speeds, wireless communication, firewalls, and gateways
      c.   Domains, hyperlinks, homepages, favorites/bookmarks, plugins, tabs, and downloads/uploads

Electronic Communication and Collaboration

27) Employ skills covered in this course (document processing, spreadsheet applications, electronic presentations, databases, Internet fluency) to complete a cross curricular project approved by the instructor. ~~(TN Writing 6, 7)~~

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12 (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12 (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Statistics and Probability.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning, depending on the projects used in each situation (for example, spreadsheets). Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advanced Computer Applications

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5904
Prerequisite(s):	*Computer Applications* (3638, 5891)
Credit:	1-2
Grade Level:	11-12
Graduation Requirements:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other Business Management & Administration courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Office Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning
Available Student Industry Certifications:	Students enrolled in this course may pursue Microsoft Office Specialist (MOS), IC^3 (GS4), or other similar certification.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	030, 037, 039, 041, 052, 054, 055, 056, 057, 152, 153, 158, 201, 203, 204, 311, 430, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Advanced Computer Applications prepares students to continue postsecondary training in business-related programs, provides advanced training for students pursuing a career in administrative and information support, and supports obtaining an industry certification in specific software applications (such as the Microsoft Office Suite). Course content and projects are meant to simulate workplace scenarios and draw on skills related to communications, operations, management, and teamwork in order to accomplish information management goals. Upon completion of this course, proficient students

will be fluent in a variety of information management software applications and will be prepared to sit for the Microsoft Office Specialist (MOS), IC³ (GS4), or other similar certification. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.**

Program of Study Application

This is the fourth and final course in the *Office Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Business Management & Administration career cluster website at **https://tn.gov/education/article/cte-cluster-business-management-administration**.

Course Standards

Secure Technology Operations

1) Correctly and safely execute basic file management operations on a typical personal computer and shared storage media, including the opening, creating, copying, moving, deleting, and renaming of files and folders, as well as searching for a specified file or folder on local hard drives, removable storage, or networked storage media. Build upon this knowledge to effectively use cloud storage and/or online digital collaboration platforms and file sharing applications. Appraise file storage needs for a given project, recommend and effectively employ the appropriate file storage and sharing solution given project characteristics. (TN Reading 3)

2) Correctly and safely import and export digital files (such as text, audio, video, and picture files in a variety of formats) from local and networked devices, choosing and employing the correct cables, removable storage media, and/or hardwired or wireless network connections. Perform basic troubleshooting as needed for enhancing productivity and optimizing performance of devices such as cameras, scanners, printers, and tablets. Perform basic operations to change file types for effective use in typical software applications. For example, connect an iPad via a wireless network, download photos from the device, and change the format of the photos from .jpg to .png format for use in a presentation application. (TN Reading 3)

Word Processing and Publishing

3) Building on standards from *Computer Applications*, create and manage professional documents of business activities to communicate with internal and external stakeholders. Fluently navigate word processing software to complete the following:
   a. Create a document from a blank document, template, imported file, or non-native document imported into word processing software
   b. Search for text within a document, insert hyperlinks, create bookmarks and use "Go To" functionality efficiently
   c. Modify page setup, select and employ appropriate document themes and style set(s) for a given project and insert headers, footers, page numbers, and watermarks
   d. Customize viewing options to effectively navigate a project using application tools such as zoom, toolbars, ribbons, macros, and shortcut keys
   e. Configure documents to scale, print, and save effectively, including maintaining backwards compatibility with previous software versions and password protecting if necessary

4) Effectively review, revise, and format text, paragraphs, and sections for a specific type of word processing file (such as a company report, memo, or invoice) by completing the following skills fluently:
   a. Revise documents using find and replace, copy and paste, AutoCorrect, and inserting special characters where needed
   b. Edit documents by changing font attributes, using format painter tools, highlighting where needed, and using WordArt
   c. Effectively determine and update paragraph, line, and character spacing
   d. Discriminate between appropriate and inappropriate ordering and grouping of text, objects, and sections, creating a professional document by preventing paragraph "widows" and "orphans," inserting breaks in pages and sections, utilizing columns where appropriate, and modifying object formatting for smooth flow of text
   (TN Reading 3, 4, 5; TN Writing 4, 5, 6)

5) Choose, employ, and manipulate text structure tools such as tables and lists to convey specific information accurately, demonstrating understanding of categories or hierarchies in the information, by completing the following skills fluently:
   a. Create a table by converting text, importing data from another application, defining table dimensions and labeling appropriately
   b. Review and modify existing tables using styles, fonts, sorting and formula capabilities, and cell margin and table dimension configurations
   c. Create and modify lists by employing bullets, numbering, and outlines and editing indention, spacing, and levels
   (TN Reading 3, 5; TN Writing 4)

6) Gather relevant information from multiple authoritative print and digital sources, assessing the strengths and limitations of each source, and integrate the source accurately into the document using citations, references, and footnotes. Select appropriate notation formatting for a given style, such as Modern Language Association (MLA), American Psychological Association (APA), or the Chicago Manual of Style.
   a. Integrate information into the text selectively to maintain the flow of ideas, avoid plagiarism, and over-reliance on any one source
   b. Insert, manage the locations, and auto-update endnotes, footnotes, citations, and bibliographies following a standard format
   c. Add and modify the font, format, location, and position of captions
   (TN Reading 1, 3, 8; TN Writing 4, 8, 9)

7) Integrate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
   a. Insert quick parts, textboxes, and customizable building blocks
   b. Insert and format simple shapes and SmartArt, formatting their properties (color, size, shape) and text wrapping to seamlessly integrate into document
   c. Insert and format image files, including modifying with effects and updating properties to ensure effective integration with text and other objects
   (TN Reading 3, 5, 7, 9; TN Writing 4, 7)

Spreadsheet Applications

8) Building on standards from *Computer Applications*, use a spreadsheet application to create and manage worksheets and workbooks for business functions such as invoices, financial statements, data review and summarization, and statistical analysis.
   a. Create new workbooks from blank worksheets, templates, imported and non-native files
   b. Navigate through existing workbooks by searching for specific data, inserting hyperlinks, changing worksheet order and using "Go To" and "Name Box" functions
   c. Format worksheets and workbooks using colors, page setup options, columns and rows, themes, watermarks, headers and footers, and setting data validation
   d. Customize options and views for workbooks, including hiding columns, rows, and worksheets, editing toolbars, ribbons, and macros, freezing panes and utilizing short cut keys
   e. Configure worksheets and workbooks for effective printing and saving, including setting print area, changing file formats, setting print scaling, and maintaining backwards compatibility if needed
   (TN Reading 3)

9) Given a specific document purpose, accurately create cells and ranges to effectively manage data, draw conclusions from analysis, and structure for ease of readability.
   a. Insert, review, and append data in cells and ranges using find and replace, copy and paste, AutoFill, expanding data across cells, and inserting and deleting cells
   b. Format cells and ranges for a given purpose, including merging cells, modifying alignment, font, wrap-text, and indentation and employing WordArt and number formatting when appropriate
   c. Order and group cells and ranges by applying conditional formatting, inserting sparklines, transposing columns and rows, creating named ranges, inserting subtotals, and collapsing groups of data
   (TN Reading 3, 5)

10) Translate quantitative or technical information between text, visuals, data, and equations by accurately creating and using tables.
   a. Effectively navigate between tables and ranges, adding or removing cells and defining titles
   b. Modify styles and format of a table to convey meaning, including applying styles, banding rows and columns, and inserting totals or averages
   c. Filter and sort information effectively, including filtering records, sorting data on multiple columns, changing sort order to highlight specific information, and removing duplicates to enhance analysis (TN Reading 3, 5, 7, 9)

11) Accurately determine appropriate calculations (formulas and functions) for analysis to draw conclusions about sets of data, including:
   a. Utilize cell range and references (relative, mixed, absolute) to complete functions accurately based on specific question sought to address, including accurate understanding of order of operations
   b. Summarize data with functions such as sum, average, minimum, maximum, and count

       c.   Utilize conditional logic in functions (if-then statements) to accurately discriminate data for analysis

       d.   Format and modify text with functions

~~(TN Reading 3; TN Math N-Q)~~

12) Analyze needed structure and objects (such as charts and graphs) to convey particular meaning or draw conclusions from a dataset.
   a. Create charts and graphs that summarize appropriate data series, including differentiating between rows and columns in source data
   b. Format charts and graphs by modifying legends, sizes, parameters, layouts and styles and positioning
   c. Insert and format an object (such as a textbox, SmartArt or image) and format its border, positioning, properties, styles and effects and colors

~~(TN Reading 3, 4, 6, 7; TN Writing 4, 6)~~

Presentation Software

13) Building on standards from *Computer Applications*, use presentation software to create and manage clear and coherent multimedia presentation materials for a given audience, task, purpose, and length of presentation. Fluently navigate software to:
   a. Create new presentations from blank slides, templates, and important files and/or file content (such as outlines or text from word processing files)
   b. Format a presentation to achieve a style appropriate to a given audience and industry by applying slide masters, layouts, background images, page numbers, headers and footers, and presentation themes
   c. Customize presentation options and views to ensure accurate page setup, printing (color/grayscale), and navigation
   d. Configure presentations to print for handouts or notes and save to maintain appropriate settings by determining most applicable handout print options, package presentations for CD, save presentations as webpages, and maintain backwards compatibility where needed
   e. Configure and present slideshows in a public speaking setting, paying close attention to slide timing, resolution, annotations, options, and appropriate views for a given presentation venue

~~(TN Reading 3; TN Writing 4)~~

14) For a given content, select and employ appropriate structure to convey meaning and organize information into categories and hierarchies appropriately, including:
   a. Add slide layouts, duplicate, hide, and delete slides, and modify slide backgrounds and styles
   b. Insert and format shapes, including applying borders, resizing, and applying styles to both custom and template shapes
   c. Order and group shapes and slides by inserting section headers, modifying slide order, aligning and grouping shapes, and displaying gridlines

~~(TN Reading 3, 5)~~

15) Create slide content that is clear and coherent, in which the development, organization, and style are appropriate to a given task, purpose, and audience, including:

a. Insert and format text such as WordArt, columns, hyperlinks, and bulleted and numbered lists
   b. Insert and format tables and charts, including modifying rows, columns, and legends, applying styles, modifying parameters and importing from external sources
   c. Insert and format SmartArt and images, including adding shapes, changing colors, adding and moving text, resize, crop, and apply styles
   d. Insert and format appropriate media, including video and audio clips, by adjusting window size, setting start/stop times, setting options, and linking to external sources
   ~~(TN Reading 3, 7, 9; TN Writing 4, 8)~~

16) Effectively employ transitions and animations to convey meaning without distracting from slide content.
   a. Insert transitions between slides, manage multiple transitions, and modify transition effect options
   b. Animate slide content including applying animations to shapes and paths and modifying animation properties
   c. Set timings for transitions and animations to ensure appropriate duration, order, and start/stop times for effects
   ~~(TN Reading 3, 6)~~

17) Develop, manage, and strengthen content by planning, revising, and editing presentations, including:
   a. Merge content from multiple presentations and reuse appropriate slides with separate or similar formatting
   b. Track changes and resolve differences (such as discarding changes or managing comments) to focus on what is most significant for a specific purpose and audience
   c. Protect and share presentations using encryption, passwords, media compression, and permissions, while ensuring accessibility and compatibility are maintained for a given situation or scenario
   ~~(TN Reading 3; TN Writing 5)~~

Information Management & Integration

18) Throughout the course, conduct a sustained research project to answer a question or solve a problem. Synthesize research into an argument that is established, developed, and supported with multiple sources of data and evidence. Demonstrate authentic technical skills in word processing, presentations, and spreadsheet applications, effectively combining functionality of multiple software applications to present a coherent final project, including a report (with imported data, appendixes, etc.) and presentation with appropriate citations from text. Use selected technology to produce, publish, and update final projects. ~~(TN Reading 1, 2, 7, 8, 9; TN Writing 1, 4, 5, 6, 7, 8, 9)~~

19) Select a historical event, scientific procedure, or technical process to narrate in a comprehensive report and presentation, practicing effective word processing, spreadsheet, and presentation skills. Develop and strengthen writing and data organization through planning, revising, peer-review, editing, and rewriting throughout the course. ~~(TN Reading 1, 2, 5, 7, 9; TN Writing 2, 4, 5, 6, 7, 8, 9)~~

Note: Teachers who want to provide additional training in database operations and/or additional software applications (such as email platforms), may add to these standards to create an honors or two-credit course. For additional recommendations on this option, please reach out to the cluster consultant.

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/ Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Business Economics

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5898
Prerequisite(s):	None
Credit:	½
Grade Level:	11-12
Graduation Requirements:	Satisfies one-half credit in U.S. Government
Programs of Study and Sequence:	This course is available for elective credit in the Business, Management & Administration and Law, Public Safety, Corrections & Security career clusters.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org/ Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit http://tn.gov/education/cte/work_based_learning.shtml.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit or dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution.
Teacher Endorsement(s):	030, 035, 039, 052, 054, 152, 153, 158, 201, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

This course provides an in-depth study of fundamental concepts, free enterprise trading practices, and the various players in the economic system. Topics include the production, marketing, and distribution of goods and services, as well as the roles of financial institutions, the government, and the individual within the free enterprise system. Students will explore various careers related to the economy.

International trade and economics have become an integral part of Business Economics. *(Specific activities will require use of Internet, word processing, and spreadsheet software.)*

Course Standards

Standard 1.0

The student will develop and apply concepts related to human relations, safety, career development, communications and leadership skills for a global workplace.

The student will:

1.1 Demonstrate sensitivity to personal, societal, corporate, and governmental responsibility to community and global issues.

1.2 Demonstrate the interpersonal, teamwork, and leadership skills needed to function in diverse business settings, including the global marketplace.

1.3 Communicate effectively as writers, listeners, and speakers in diverse social and business settings.

1.4 Apply the critical-thinking and soft skills needed to function in students' multiple roles as citizens, consumers, workers, managers, business owners, and directors of their own futures.

1.5 Analyze and follow policies for managing legal and ethical issues in organizations and in a technology-based society.

1.6 Investigate the life-long learning skills that foster flexible career paths and confidence in adapting to a workplace that demands constant retooling.

1.7 Assess personal skills, abilities, aptitudes, and personal strengths and weaknesses as they relate to career exploration and apply knowledge gained from individual assessment to research and develop an individual career plan.

1.8 Examine the goals and principles of Future Business Leaders of America.

1.9 Investigate online and office safety procedures and pass a written safety examination with 100% accuracy.

1.10 Demonstrate parliamentary procedure through office staff/chapter organizational meetings.

1.11 Apply appropriate typography concepts to industry documents.

Sample Performance Task

➢ Design and produce a team project on legal and ethical issues that includes issues and penalties for plagiarism, copied data with permission and the process used in obtaining permission. Obtain formal permission for use of quotations, art form, design, music, and photographs. Develop and present a total team project utilizing various technology components and appropriate typography concepts.

Standard 2.0

Students will analyze the basic economic systems in relation to scarcity, choice, and opportunity costs.

The student will:

2.1   Apply the concepts of basic economics.
2.2   Differentiate between economic systems.
2.3   Analyze economic problems and goals of society.
2.4   Analyze the economic problem of scarcity.
2.5   Assess the importance of natural resources and their relationship to economic decision making.

Sample Performance Task

➢   The students will write a scenario of a group of people being stranded on a deserted island. The students must decide what type of economic system to create. In answering that question, they must answer the three basic economic questions—what to produce, how to produce, and for whom to produce. This activity will force the students to explore trade-offs and opportunity costs.

➢   The assignment could be accomplished through a written paper, a skit, a multimedia presentation, etc.

Standard 3.0

Students will analyze the role of business in a free enterprise system.

The student will:

3.1   Connect concepts as they apply to the role of business in a free enterprise system.
3.2   Analyze types of business organizations.
3.3   Apply the concepts of buying and selling of stock.
3.4   Analyze effects of competition and monopoly on a free enterprise system.
3.5   Apply the concepts of production.
3.6   Analyze characteristics of marketing.
3.7   Differentiate between factors of production.
3.8   Explain the phenomena in terms of the law of supply and demand.
3.9   Formulate and analyze knowledge/understanding of elasticity of demand.
3.10   Analyze the role of unions in the economy.

Sample Performance Task

➢   The students will gather information about the forms of business—sole proprietorship, partnership, corporation, and limited liability company. They should use several sources of information (primary and secondary). Once the information is gathered, the students will create an interactive multimedia presentation and a written paper exploring the details of each type of business. The details should include the following:
  ➢   Type of business
  ➢   Characteristics of the type of business
  ➢   Discussion of products/services within each business types
  ➢   Competition within business type

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➢ Use of illustrations of supply and demand curves for elastic and inelastic products in business

Standard 4.0

Students will analyze the role of the individual in a free enterprise system.

The student will:

4.1 Connect concepts as they apply to the individual's role in a free enterprise system.
4.2 Apply concepts demonstrating the elements of personal and fiscal responsibility.
4.3 Critique and analyze types of savings plans.
4.4 Investigate and analyze the appropriate use of credit.
4.5 Differentiate between the most common forms of insurance and formulate a personal needs assessment.

Sample Performance Task

➢ Students will develop a personal consumer portfolio. The portfolio will include the following:
  ➢ A budget
  ➢ Personal savings/retirement plan
  ➢ Insurance options and planning
  ➢ Home/car purchasing plan
  ➢ Credit assessment
➢ The assignment will be written and given as an oral presentation. The student will include statements from credit plans, insurance brochures, notes from interviews with different people, Internet, etc., to support their research.

Standard 5.0

Students will analyze the role of government in a free enterprise system.

The student will:

5.1 Connect concepts related to government's role in a free enterprise system.
5.2 Formulate and analyze the components of gross national product (GNP), gross domestic product (GDP) and national income.
5.3 Investigate and differentiate the types of taxes.
5.4 Analyze the concept of governmental distribution of wealth.
5.5 Analyze cause/effect of inflation and recession.
5.6 Investigate and analyze the impact of the American financial structure, including banking and monetary policy.
5.7 Investigate and analyze governmental policies and their economic consequences at the national, state and local levels.

Sample Performance Task

- ➢ Students should create an illustration of the circular flow of money, focusing on the government section of the circular flow. When doing so, they will create a table showing how the government collects money and distributes those tax dollars. They will also include the government's responsibility to consumers and businesses as part of their role in the free enterprise system.
- ➢ Students will both write and orally present this assignment.

Standard 6.0

Students will analyze economic concepts.

The student will:

6.1   Connect concepts as they apply to international economics.
6.2   Investigate and analyze the effect of world trade on the United States economy.
6.3   Utilize business economic concepts to determine advantages/disadvantages of International trade, including the global impact.
6.4   Develop a logical argument for/against protective trade barriers.
6.5   Investigate the purpose of foreign aid.
6.6   Analyze the cause and effect of reliance on foreign aid.

Sample Performance Task

- ➢ Students will research international trade and its effect on the free enterprise system. Each student will select a product and trace its origination. Compare and contrast the benefits of foreign trade and domestic trade within the U.S. (include discussion of tariffs).
- ➢ This assignment can be in the form of a class debate where half of the class represents domestic trade and the other half of the class represents international trade.

Standard 7.0

Students will analyze careers in business economics.

The student will:

7.1   Analyze and synthesize opportunities for careers related to business economics.
7.2   Analyze current employment trends for careers related to business economics across industries.

Sample Performance Task

- ➢ Students should complete a career research portfolio and make an oral presentation on the portfolio development process. The portfolio will include the following areas:
  - ➢Traditional research about various careers in business/economics
  - ➢A shadowing experience in one of the careers
  - ➢An interactive multimedia presentation

Standard 8.0

Students will identify market structures/forms of competition found in the U.S. economy.

The student will:

8.1   Analyze, compare and contrast perfect competition and monopolistic competition.
8.2   Analyze, compare, and contrast oligopoly and monopoly.
8.3   Connect government regulation to the creation of natural monopolies.

Sample Performance Task

➢   As a team students will research, develop, and present a visual presentation comparing and contrasting different types of market competition. The research will include the following:
   ➢   Perfect competition
   ➢   Monopolistic competition
   ➢   Oligopoly
   ➢   Monopoly

Personal Finance

Primary Career Cluster:	Business Management & Administration
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5901
Prerequisite(s):	None
Credit:	½
Grade Level:	9 - 12
Graduation Requirements:	*Personal Finance* is required for graduation.
Programs of Study and Sequence:	This is an elective course in the Finance career cluster.
Aligned Student Organization(s):	DECA: http://www.decatn.org; FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning .
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to your local postsecondary institution(s) for more information.
Teacher Endorsements:	024, 030, 031, 032, 033, 034, 035, 036, 037, 038, 039, 041, 050, 051, 052, 054, 055, 056, 057, 130, 152, 153, 158, 201, 202, 203, 204, 311, 424, 430, 431, 432, 433, 434, 435, 436, 450, 471, 472, 474, 475, 476, OR any CTE Professional license with state approved training
Required Teacher Certifications/Training:	Training is only required for those endorsements that are NOT specified. Teachers who do not have the endorsements listed must attend the state approved training to teach personal finance.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-business-management-administration

Course Description

Personal Finance is a foundational course designed to inform students how individual choices directly influence occupational goals, future earning potential, and long term financial well-being. The standards in this course cover decision-making skills related to goal setting, earning potential, budgeting, saving, borrowing, managing risk, and investing. The course helps students meet the growing complexities of

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personal financial management and consumer decision making. Upon completion of this course, proficient students will understand how their decisions will impact their future financial well-being. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, as well as Tennessee Economics standards.*~~

Program of Study Application

This is an elective course in the finance career cluster. For more information on the benefits and requirements of implementing finance programs, please see the program of study description documents found on the Finance career cluster website https://tn.gov/education/article/cte-cluster-finance.

Personal Finance is a required course for graduation for all Tennessee high school students.

Course Standards

Financial Responsibility and Personal Decision Making

1) Define the concept of personal finance and explain the importance of personal financial planning using information sources such as instructional materials, news articles, blogs from reputable sources, personal narratives, and industry publications. ~~(TN Reading 1, 4)~~

2) Write long-term (over 5 years), mid-term (1 - 5 years), and short-term (a year or less) personal financial goals, defining desired education, career, and earning milestones and saving and spending plans. Evaluate factors that may influence the goals, including family responsibilities, individual values, and economic conditions. ~~(TN Reading 4; TN Writing 4; TN Economics)~~

Education, Careers, and Income

3) Develop a chart, table, or graphic to compare characteristics of various careers, such as alignment to personal interest and aptitude, education requirements, available positions, salaries, potential lifetime earnings, and employer benefits. Research and report (orally or in an explanatory text) the requirements for admission to and related costs of attending a specific postsecondary institution and how that will support education, career, and earning goals. ~~(TN Reading 2, 3, 7; TN Writing 2, 6)~~

4) Demonstrate an understanding of Free Application for Federal Student Aid (FAFSA) requirements to apply for postsecondary education financial aid by completing an application. Identify strategies for reducing the overall cost of postsecondary education, including the impact of scholarships, grants, work study, and other assistance. ~~(TN Reading 7; TN Writing 4, 7)~~

5) Research multiple viewpoints that support or question the use of student loan debt in paying for postsecondary education. Assess the extent to which the reasoning and evidence presented support the author's claim. Citing specific textual evidence, craft an argumentative essay that either supports or opposes the use of student loan debt, developing both claim(s) and counterclaim(s) fairly. ~~(TN Reading 6, 7, 9; TN Writing 1, 4, 8, 9)~~

6) Describe factors affecting take-home pay such as tax withholdings, benefits (e.g., insurance, 401k), and plan payroll deductions. Complete a 1040EZ or 1040A and a W-4 Employee's

Withholding Allowance paperwork, and analyze the W-2 Wage and Tax Statement for federal income tax purposes. (TN Reading 3)

Planning and Money Management

7) Create a personal balance sheet. Determine assets and liabilities and calculate net worth. Using research from local sources (such as newspapers, chambers of commerce, local government, and company websites), create a monthly personal budget. Cite specific textual evidence from findings when calculating earnings of a selected occupation and including accurately estimated household living expenses, taxes, potential savings, and an emergency fund. (TN Reading 1, 7; TN Writing 4, 7)

8) Understand the availability of consumer protection laws, agencies, and resources. Investigate the availability and reliability of resources to assist consumers in making buying decisions (include national, state, and local resources, as appropriate). (TN Reading 8)

9) Compare and contrast services and products available from financial service providers such as commercial banks, savings and loans, and credit unions. Identify the services that best support the personal financial goals. Craft an argumentative essay supported by evidence about selecting a specific financial account or service to best meet current and/or future financial goals. (TN Reading 9; TN Writing 1, 4, 9)

Credit and Debt

10) Compare and contrast the various sources and types of consumer credit, such as student loans, auto loans, store credit cards, and payday loans. Draw conclusions about the types of credit best suited for financing and/or purchasing various goods and services, defending claims with specific textual evidence. (TN Reading 1, 5, 9; TN Writing 4, TN Economics)

11) Citing information from at least one of the three major credit reporting agencies, describe credit reports and credit scores. Describe the relationship between consumers and credit reports/credit scores, discussing their importance and citing specific textual evidence from research. Analyze a sample credit report and interpret how the contents may affect the credit score. Explain how the credit score may impact borrowing opportunities and the cost of credit. Summarize specific activities used to maintain a good credit score. (TN Reading 1, 2, 5; TN Writing 4, 7, 9)

12) Citing evidence found in credit applications, compare and contrast various types of credit and calculate the real cost of borrowing. Explain factors that can affect the approval process associated with each type. Identify typical information and procedures required in the credit application process. Analyze factors associated with the purchase of an automobile and defend a specific buying decision, including:
   a. Define and understand factors most often included in negotiations (such as cash vs. financing, inclusion of trade-in, etc.).
   b. Evaluate costs and benefits of different service contract and/or warranty options.
   c. Compare and contrast available financing options based on consumer characteristics and size of down payment.
   (TN Reading 2, 3, 4, 9; TN Writing 9; TN Math N-Q)

13) Identify strategies for good use of credit and effective debt management to recognize the warning signs of impending debt problems. Illustrate the long-term consequences of accumulating debt and of filing for bankruptcy. Formulate a plan to eliminate debt and determine the impact on a personal budget, citing specific textual evidence to defend elements of the plan. (TN Writing 4, 8, 9)

Risk Management

14) Differentiate the benefits and costs associated with various types of insurance, such as health, life, property, and auto. Describe the risks associated with a lack of appropriate coverage in specific situations. Determine the role of insurance in personal financial planning to preserve and build wealth. (TN Reading 4, 5)

15) Conduct assessments of various types of identity theft situations and scams, then determine strategies and present a plan to safeguard and protect against identity theft. Design and present a plan to significantly lower and protect against risks. Determine steps that should be taken by a victim of identity theft to report the incident and re-establish identity. (TN Writing 4, 9)

Saving and Investing

16) Explain how saving and investing contribute to financial well-being, building wealth, and helping meet personal financial goals. Compare and contrast saving and investment strategies, such as savings accounts, certificates of deposit, stocks, bonds, mutual funds, employer sponsored savings plans, physical assets, and commodities.. Design a diversified saving and investment plan that includes strategies compatible with personal goals. Include time value of money and compound interest calculations in analysis. (TN Reading 4, 5; TN Writing 4, TN Mathematics F-IF)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 8, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.
- TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.
  - Note: The standards in this course are not meant to teach economics concepts. However, the concepts referenced above may provide teachers with opportunities to

- ~~collaborate with economics educators to design project based activities or collaborate on lesson planning.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number, Quantity, Functions.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Fundamentals of Education

Primary Career Cluster:	Education and Training
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6123
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Education and Training courses.
Programs of Study and Sequence:	This is the first course in the *Teaching as a Profession, Early Childhood Education,* and *Educational Support Careers* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-education-training

Course Description

Fundamentals of Education is a foundational course in the Education and Training career cluster for students interested in learning more about becoming a school counselor, teacher, librarian, or speech-language pathologist. Upon completion of this course, proficient students will gain knowledge in the history of education in the United States, careers in education, and the influence of human development on learning. Artifacts will be created for inclusion in a portfolio, which will continue throughout the full

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sequence of courses. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee state standards in Biology I, Psychology, Sociology, U.S. Government and Civics, and U.S. History and Geography, as well as National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This is the foundational course in the *Teaching as a Profession, Early Childhood Education,* and *Educational Support Careers* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Education and Training website at https://tn.gov/education/article/cte-cluster-education-training.

Course Standards

Foundations of Education

1) Synthesize research from informational texts to create an annotated timeline (Post-Civil War to the present) of significant events in the history of U.S. public education. Examples of events include but are not limited to: the establishment of the first public school, major U.S. Supreme Court cases, the Vocational Rehabilitation Act, desegregation, Title IX, and No Child Left Behind. ~~(TN Reading 2, 7; TN Writing 2, 9; TN U.S. Government and Civics 18, 46, 48; TN U.S. History and Geography 38, 89, 92; FACS 4)~~

2) Gather and analyze information from multiple authoritative sources to assess the impact of important cultural and societal events on the evolution of the U.S. education system. Examples of events include but are not limited to: WWII, Sputnik and the space race, the passage of the Civil Rights Act, The Great Society, the development of the Internet, and national tragedies such as 9/11. ~~(TN Reading 1; TN Writing 1, 9; TN U.S. Government and Civics 18, 46, 48; TN U.S. History and Geography 38, 89, 92)~~

3) Research and summarize in a clear and coherent narrative the influences of major educational theorists' philosophies. Evaluate the validity theories by assessing the extent to which the reasoning and evidence of each theorist support their claims. Examples of theorists include but are not limited to:
   a. John Dewey
   b. Maria Montessori
   c. Benjamin Bloom
   ~~(TN Reading 6, 8; TN Writing 2, 7; FACS 4)~~

4) Create an annotated graphic illustration of the U.S. education system from pre-K through postsecondary education. The graphic should include evidence from informational texts about the structure of local school districts, state governing bodies, and federal authorities with appropriate supporting citations to demonstrate knowledge of common citation conventions. ~~(TN Writing 9)~~

Careers in Education

5) Identify and analyze career pathways within the Education and Training cluster. Use supporting evidence from multiple sources, such as local job postings and Tennessee Department of Labor and Workforce Development data, to describe the essential knowledge and skills required for these careers. Complete one or more career aptitude surveys, analyze the results, and discuss in an essay how personal career aptitudes align with careers in education. Careers may include the following:
   a. Teacher
   b. Librarian
   c. Educational technologist
   d. Counselor
   e. Interpreter
   f. Speech pathologist
   g. Consulting teacher for students with special needs
   (TN Reading 1, 7, 9; TN Writing 7, 8, 9; FACS 4, 13)

6) Compile and analyze real-time labor market data, including economic and demographic trends, and compare with authentic vacancy announcements on local and national job boards. Use this information to compare and contrast occupations by education requirements, job availability, salaries, and benefits. (TN Writing 8, 9; FACS 4)

Educator Responsibilities and Aptitudes

7) Interview professionals in the education field to gather information about their roles and responsibilities. Categorize the range of tasks that different educators are responsible for and estimate the time spent on each one. Write informative narratives exploring multiple facets of common teaching activities, such as:
   a. Planning effective instruction
   b. Facilitating instruction by using multiple teaching methods
   c. Assessing student learning
   d. Non-instructional tasks (such as parent communication, building activities, etc)
   (TN Reading 9; TN Writing 2, 9; FACS 4)

8) Describe the aptitudes, including 21st century skills, needed by education professionals; create a rubric for self-assessing 21st century skills, such as the ability to:
   a. Communicate verbally and nonverbally in a respectful manner
   b. Work effectively in teams and resolve conflicts when necessary
   c. Demonstrate a positive work ethic
   d. Understand different cultural perspectives and their impact in the classroom
   e. Use technology
   f. Adapt to changes
   g. Manage time wisely
   (TN Reading 2; TN Writing 4; FACS 13)

9) Using the self-assessment rubric created during this course, establish a baseline evaluation of 21st century skills, attitudes, and work habits. Create a growth plan promoting advancement of skills and abilities that will be placed in the course portfolio.

Introduction to Human Development

10) Compare and contrast physical, emotional, cognitive, and social milestones of development from toddlerhood through adolescence. Research and summarize, in an informative narrative, specific psychological theories about human development. Illustrate the differences in major developmental theories and milestones. (TN Reading 1, 6; TN Writing 1; TN Psychology 38, 41, 42, 43, 44, 46, 47 ; FACS 12)

11) Create an annotated model or graphic illustration of the parts of the human brain, detailing their principle functions as they relate to physical and cognitive development. Draft a companion representation of the stages of human development in the form of a timeline from toddlerhood through early adulthood. Draw conclusions from informational texts about the most important influences on and relationships among brain development, reasoning capacity, and learning. Define brain plasticity and describe how it changes over the lifespan. (TN Reading 5; TN Biology I 4; TN Psychology 13, 14; FACS 4, 12)

12) Analyze the factors that contribute to personality and investigate several research-based personality assessment tools. Use evidence from informational texts to support analysis and reflection on the connections among personality, life experience, environment, and brain development. (TN Reading 9; TN Psychology 33, 43, 46; FACS 12)

Introduction to Learning

13) Synthesize and cite information from reliable academic sources to describe and critique major approaches to theories of human learning, including but not limited to:
   a. Classical Conditioning (Ivan Pavlov)
   b. Stage Theory of Cognitive Development (Jean Piaget)
   c. Social Learning Theory (Lev Vygotsky)
   d. Constructivism (Jerome Bruner)
   e. Experiential Learning (David Kolb)
   f. Multiple intelligences (Howard Gardener)
   Write an informative narrative explaining the influence of these and other theories on teaching practices. (TN Reading 1, 4; TN Writing 1, 2, 7, 8, 9; TN Psychology 33, 38; FACS 12)

14) Research the influence of the following factors on student self-concept and academic performance:
   a. Student experience, interests, aptitudes, family, and culture
   b. Teacher behavior and attitudes
   c. Peers
   (TN Reading 1, 2, 9; TN Writing 1; TN Psychology 43, 47, 55, 56, 70; TN Sociology 11, 20; FACS 4)

Career Portfolio

15) Create an electronic professional portfolio, using narrative and visual elements to connect personal career preparation artifacts to concepts learned in this course. (TN Writing 2, 4, 6; FACS 4, 13)

16) Synthesize information from Education and Training career exploration to create a written or electronic career pathway plan outlining academic and career achievement goals, as well as a timeline for ongoing reflection throughout the program of study coursework.
   a. Identify dual credit courses available within specific programs of study
   b. Gather information from postsecondary institution websites and compare community college and university education programs that align with secondary programs of study
   (TN Reading 7; TN Writing 2, 4, 6, 8; FACS 4)

17) Drawing upon content in this course, write a definition of *teaching philosophy*, develop and support a claim about its significance to student learning, and create a personal teaching philosophy for inclusion in the professional portfolio. (TN Reading 1, 7; TN Writing 1, 4, 6, 9)

The following artifacts will reside in the student's portfolio:
- History of Education graphic
- Educational Theorists narrative
- U.S. Education System graphic
- Career Aptitude Survey results and comparison
- Career exploration graphic
- Educator Responsibilities and Aptitudes graphics
- Introduction to Human Development chart and narrative
- Brain development graphic
- Human Development Personality narrative
- Introduction to Learning narrative
- Peer Influence Investigation artifacts
- Career Pathway plan
- Teaching Philosophy

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Biology I: Tennessee Science: Biology I standards may provide additional insight and activities for educators.
- TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.

- TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.
- TN U.S. Government and Civics: Tennessee Social Studies U.S. Government and Civics standards may provide additional insight and activities for educators.
- TN U.S. History and Geography: Tennessee Social Studies: U.S. History and Geography standards may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Teaching as a Profession I (TAP I)

Primary Career Cluster:	Education and Training
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6010
Prerequisite(s):	*Fundamentals of Education* (6123)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Education and Training courses.
Programs of Study and Sequence:	This is the second course in both the *Teaching as a Profession* and *Educational Support Careers* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently local dual credit opportunities with specific community colleges, including Roane State Community College.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-education-training

Course Description

Teaching as a Profession I (TAP I) is an intermediate course for students interested in learning more about becoming a school counselor, teacher, librarian, or speech-language pathologist. This course covers the components of instruction, teaching strategies, types of assessments, student learning, special populations, and educational technology. Students will conduct observations of educators at work and create artifacts for a course portfolio, which will continue with them throughout the program of study. Upon completion of this course, proficient students will have a fundamental understanding of instructional strategies needed for becoming an educator. Standards in this course are aligned with

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the second course in the *Teaching as a Profession* and *Educational Support Careers* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Education and Training website at https://tn.gov/education/article/cte-cluster-education-training .

Course Standards

Components of Instruction

1) Identify components of effective instruction using research published by universities, scholarly journals, and educational theorists. Compare and contrast components of instructional design models. Articulate the structure of the relationships between the concepts of pedagogical cycle, curriculum, scope, and sequence. (TN Reading 4, 5; TN Writing 8, 9; FACS 4)

2) Illustrate the stages of human development and the corresponding elements of effective instruction at each stage via graph, chart and/or illustration. Prepare an accompanying informative narrative to demonstrate knowledge of how students learn and develop at each stage. Provide examples of opportunities that support intellectual, social, and personal development. (TN Writing 2, 8, 9; TN Psychology 36, 38, 43, 44, 46, 47; TN Sociology 13; FACS 4, 12)

Teaching Strategies

3) Justify why specific teaching methods have been identified as effective compared with those that research indicates are less effective, citing specific evidence. Accurately describe characteristics of, and examples of, the following effective teaching strategies:
   a. Identifying similarities and differences
   b. Reinforcing effort by providing encouragement
   c. Providing opportunities for additional practice
   d. Selecting proper instructional resources
   e. Encouraging cooperative learning
   f. Setting lesson objectives and goals for student learning
   g. Providing continuous feedback
   h. Fostering student engagement
   (TN Reading 2; TN Writing 8, 9; FACS 4)

Assessments

4) Differentiate between formative and summative assessments by comparing and contrasting the characteristics of each and describing appropriate times to employ each in an instructional setting. Articulate how each type of assessment can be used to evaluate, modify, and inform effective instruction and justify their importance.

5) Create examples of formative and summative assessments in a variety of formats (multiple choice, constructed response, true/false, essay, etc.) as an addition to the course portfolio. (TN Writing 4)

Student Learning

6) Compare and contrast a range of learning styles identified in relevant education research. Synthesize information about the characteristics of each learning style, such as examples of teaching methods and assignments in an informative text, graphic organizer, or other illustration. Learning styles include:
   a. Visual/Spatial Learners
   b. Auditory/Verbal/Linguistic Learners
   c. Analytic Learners
   d. Kinesthetic or Tactile Learners
   e. Global Learners
   (TN Reading 2, TN Psychology 26, 35; FACS 4, 12)

7) Form a hypothesis about personal learning style and complete a learning style survey to test the hypothesis. Write a summary evaluating the results of the survey, using evidence from prior research and real-life examples to develop claim(s) and counterclaim(s) that support or question the results. (TN Reading 9; TN Writing 7, 9; TN Psychology 35; FACS 12)

8) Using academic journals and news articles, investigate how social, cultural, and economic factors inside and outside of the classroom influence student learning and student behavior. Assess the extent to which reasoning and evidence in a specific text support the author's claim. (TN Reading 1, 8; TN Psychology 46, 47, 55, 56; TN Sociology 12, 13, 22; FACS 4, 12)

9) Citing research from case studies and academic journals, determine the most appropriate teaching methods to address issues of diversity in instructive and culturally sensitive ways. Write recommendations for a diversity policy that contributes to a positive classroom environment and benefits all students. (TN Reading 1; TN Writing 4, 8, 9; TN Psychology 70; FACS 4)

Special Populations

10) Research the Individuals with Disabilities Education Act (IDEA), Section 504 of the Rehabilitation Act of 1973 and Americans with Disabilities Act (ADA). Summarize the broad categories that IDEA identifies as disabilities and describe general eligibility requirements, citing specific textual evidence. Investigate the impact of these pieces of legislation on the education of students with disabilities by conducting a research project or interview(s) of impacted individuals. (TN Reading 1, 2, 6, 9; TN Writing 2, 7; TN Psychology 70)

11) Describe the roles of parents, teachers, and school administrators at an Admission, Review and Dismissal (ARD) meeting and create a visual representation of the ARD process. Examine examples of authentic individualized education programs (IEPs) designed to address the needs of students with disabilities and analyze how the required adaptations and accommodations vary from standard teaching practices. Define inclusion and least restrictive environment and justify

the importance of these concepts, citing specific textual evidence. (TN Reading 1, 2, 6, 9; TN Psychology 70)

12) Create an annotated visual representation of the key indicators, diagnostic tests, and most important features of effective instruction for students diagnosed with:
    a. Intellectual disabilities
    b. Developmental disabilities
    c. Learning disabilities
    d. Emotional/behavioral disorders
    e. Autism spectrum disorders
    f. Communication disorders
    g. Hearing loss or deafness
    h. Low vision or blindness
    i. Attention Deficit Hyperactivity Disorder (ADHD)
    (TN Reading 2; TN Writing 2, 9; TN Psychology 70)

Educational Technology

13) Research and evaluate the role of technology in the classroom by identifying available technology applications. Draw evidence from research to develop an argumentative essay on how technology can enhance or inhibit the learning process. (TN Reading 1; TN Writing 1, 9)

14) Research the Children's Internet Protection Act (CIPA) from the Federal Communication Commission (FCC) and other informational texts on internet safety for students. Synthesize and create acceptable-use policies for students that are appropriate at different developmental milestones. (TN Reading 1, 2; TN Writing 1, 9)

Final Project & Observation

15) Create a checklist or rubric synthesizing concepts studied in TAP I to use as a classroom observation tool. Perform guided observations at the elementary and secondary levels to identify characteristics of an effective classroom and teacher. Reflect on the observation experience and revise written career goals and personal teaching philosophy (developed in Level One course – Fundamentals of Education/Education Careers). Connect observations from the final project to concepts learned in this course and add these reflections to the course portfolio. (TN Reading 2; TN Writing 2, 5, 6)

The following artifacts will reside in the student's portfolio:
- Information on Instructional Strategies
- Information on Human Development
- Teaching Strategies evidence
- Assessment examples
- Information on Learning Styles
- Summary of Learning Styles
- Recommendations for Diversity Policy
- Study of factors that Impact Classroom Performance

- Annotated visual representation of Special Populations

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.~~
- ~~TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Teaching as a Profession II (TAP II)

Primary Career Cluster:	Education and Training
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6125
Prerequisite(s):	*Early Childhood Education Careers II* (6016) or *Teaching as a Profession I* (6010)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Education and Training courses.
Programs of Study and Sequence:	This is the third course in both the *Teaching as a Profession* and *Early Childhood Education* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently local dual credit opportunities with specific community colleges, including Roane State Community College.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-education-training

Course Description

Teaching as a Profession II (TAP II) is an applied-knowledge course for students interested in learning more about becoming a teacher, school counselor, librarian, or speech-language pathologist. This course covers classroom management, concepts of higher order thinking, differentiating instruction, and strategies of effective classroom planning. Students in this course will demonstrate their skills in laboratory settings while building a course portfolio of work, which will carry with them throughout the program of study. Upon completion of this course, proficient students will be prepared to take the capstone *TAP III* course and further their studies at the postsecondary level. Standards in this course are

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Program of Study Application

This is the third course in the *Teaching as a Profession* and *Early Childhood Education* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Education & Training website at https://tn.gov/education/article/cte-cluster-education-training.

Course Standards

Classroom Management and Environment

1) Research common reasons for student disobedience (such as unclear expectations, desire for attention, fear, embarrassment, or lack of basic needs) and develop a written behavior policy with clear positively-framed expectations and consequences, citing evidence from research to justify recommendations. (TN Reading 1, 5; TN Writing 2, 4, 7, 9)

2) Interview one or more experienced primary and/or secondary teachers and synthesize findings to create a checklist for performing classroom procedures and for responding to emergency situations. The checklist should include, but is not limited to: appropriate daily procedures, recognizing possible child abuse and neglect, defusing violent behavior, and responding to fire or natural disaster emergencies. (TN Writing 2, 4; FACS 4)

3) Research the correlation between classroom layout and effective classroom management. Compare the use of furniture and space in several classrooms and analyze their compliance with both research-based recommendations for effective classroom management and legal requirements for safety. (TN Reading 1, 8, 9; TN Writing 7, 9; FACS 4)

4) Drawing on evidence from research, create a rubric for evaluating the establishment of a positive classroom environment. Include indicators such as visual appearance of the classroom, effective time management, student engagement, and teacher interaction with students. (TN Reading 1, 3; TN Writing 2, 9; TN Psychology 47; TN Sociology 15, 20; FACS 4)

Teaching for Higher Order Thinking

5) Investigate theories (such as those proposed by Benjamin Bloom, Robert Marzano, and Norman Webb) on instructional strategies and activities that promote the development of higher level cognitive skills. Create and annotate a graphic illustration aligning Webb's Depth of Knowledge and/or Bloom's Taxonomy with teaching methods at each skill level. (TN Reading 1, 2, 5, 7; TN Writing 2, 4, 8, 9; TN Psychology 38; FACS 4, 12)

6) Research various reflection strategies and make a claim about how reflection strategies influence academic achievement and student understanding. Develop claim(s) and counterclaim(s) about the relationships between the use of reflection strategies, improvement of student understanding and academic achievement, with reasoning and evidence from texts. (TN Reading 1, 6; TN Writing 1, 4, 7, 9; FACS 4, 12)

7) Gather research on the major elements of successful cooperative/collaborative learning and their relationship to higher order thinking skills. Design small group instructional activities incorporating those elements. (TN Reading 1, 2; TN Writing 2, 4, 7, 9; FACS 4)

Differentiating Instruction

8) Define differentiated instruction. Citing specific textual evidence about characteristics of certain learners, create examples of instructional methods that differentiate instruction to meet the educational needs of students based on:
   a. Language
   b. Culture
   c. Socioeconomic status (SES)
   d. Educational background
   e. Preferred learning style
   f. Gender
   g. Ethnicity
   h. Religion
   (TN Reading 1, 4, 9; TN Writing 2, 4, 9; FACS 12)

9) Discuss and demonstrate modifications in the classroom to accommodate exceptional learners, including students with disabilities and those identified as gifted, citing specific textual evidence from research on effective teaching practices. (TN Reading 3; TN Psychology 66, 70)

Planning for Instruction

10) Investigate relevant national and state curriculum standards, and explain how they help guide teaching in order to affect learning. (TN Reading 1, 6)

11) Working collaboratively in pairings or small teams, gather and analyze Tennessee course content requirements in different subject areas and grade levels. Compare and contrast examples of student learning objectives and performance indicators from different subject areas and grade levels. Analyze the extent to which each provides teachers with necessary expectations for instruction. Choose a specific standard to rewrite for clarity and measurability. (TN Reading 9; TN Writing 2, 4, 5)

12) Drawing evidence from academic research, create a rubric for evaluating and selecting textbooks, materials, and technology resources. Examples of criteria to be analyzed include but are not limited to:
   a. Reading level
   b. Content accuracy
   c. Alignment with content standards
   d. Visual appeal
   e. Adaptability for different student populations
   f. Non-stereotyped representation of groups from different cultures or ethnic backgrounds.
   (TN Reading 1; TN Writing 4, 6, 9)

13) Conduct a research project on lesson planning in multiple grade levels and subject areas. Identify the typical components of lesson planning documents and create a lesson plan template that incorporates components such as:
   a. Content-area, Common Core, and 21st Century Skills standards
   b. Student learning objectives aligned to standards
   c. Materials and equipment needed
   d. Instructional activities
   e. Pacing chart
   f. Accommodations for special needs students
   g. Closure/reflection
   h. Assessment
   (TN Reading 9; TN Writing 7, 9)

14) Research and analyze individual and group teaching strategies. Craft an argumentative essay making a claim about the appropriate strategy for a given situation, developing claim(s) and counterclaim(s) with evidence and reasoning from academic research.
   (TN Reading 1, 2; TN Writing 1, 8, 9)

Final Project

15) Apply knowledge from this course by demonstrating specific instructional strategies in a classroom situation. Document artifacts from the capstone project in the course portfolio. Demonstration of knowledge includes, but is not limited to, the following activities:
   a. Using a lesson plan template to produce effective standards-based, subject-specific lesson plans for teaching students at multiple grade levels
   b. Implementing standards-based lessons (created in this course) with small groups, using developmentally-appropriate teaching strategies that promote student learning and higher order thinking skills
   c. Selecting and using multiple types of resources and teaching methods
   d. Creating a classroom floor plan designed to provide equitable access and maximize learning for all students
   e. Evaluating student levels in order to adapt lessons for differentiated instruction
   f. Establishing a positive classroom climate

The following artifacts will reside in the student's course portfolio:
- Lesson plans and revisions
- Teaching journal reflecting on lesson effectiveness, positive and negative aspects of the experience, self-assessment, plans for refining instructional practice
- Feedback from supervising teacher
- Revised statement of personal teaching philosophy
- Revised career and professional growth plan

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.~~
- ~~TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

School Counseling

Primary Career Cluster:	Education & Training
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6124
Prerequisite(s):	*Teaching as a Profession I* (6010)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Education and Training courses.
Programs of Study and Sequence:	This is the third course in the *Educational Support Careers* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-education-training

Course Description

School Counseling is an applied-knowledge course in the Education and Training career cluster for students interested in learning more about becoming school counselors. The course covers the history of the profession, career investigation, professional ethics, school counseling models, counseling approaches for a range of ages, and communication skills. In addition, students will complete a job-shadowing experience. Artifacts will be created to add to the portfolio started in the foundational course, which students will continue to build throughout the program of study. Upon completion of this course, proficient students will be prepared for further study in school counseling at the postsecondary level. Standards in this course are aligned with Tennessee State Standards for English Language Arts &

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Program of Study Application

This is the third course in the *Educational Support Careers* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Education and Training website at https://tn.gov/education/article/cte-cluster-education-training.

Course Standards

History of School Counseling

1) Research and summarize in a clear and coherent narrative the influence of significant contributors to the history and development of school counseling in schools in the United States. Create a timeline or graphic illustration that represents when each of these major figures lived and highlights their unique contributions. (TN Reading 2, 7; TN Writing 2; FACS 4)

Career Investigation

2) Compile and analyze real-time labor market data, as well as economic and demographic trends, and compare with authentic vacancy announcements on local and national job boards. Use this information to describe counselor education and licensing requirements, job availability, salaries, and benefits as school guidance counselors. (TN Reading 2; TN Writing 4, 9; FACS 4)

3) Citing specific textual evidence from Tennessee State Laws and Tennessee State Board of Education Policy Rules and Regulations, document the roles of counselors in serving students, parents, and staff in schools, explaining the difference between direct and indirect services. Duties may include but are not limited to:
    a. Administering diagnostic and placement tests
    b. Providing academic advisement and course scheduling
    c. Guiding career and college readiness activities
    d. Advocating for students with special needs
    e. Conducting parent conferences
    f. Handling discipline referrals
    g. Counseling individual students
    (TN Reading 1, 2, 4; TN Writing 4, 9)

4) Analyze the relationship between the knowledge, abilities, skills, and attitudes outlined in the American School Counselor Association (ASCA) Competencies and the importance of graduate degrees in hiring and advancement. Revisit and revise where appropriate the career pathway plan, which outlines academic and career achievement goals created in the Fundamentals of Education course with findings. (TN Reading 2; TN Writing 6, 9)

Professional Ethics

5) Research professional ethical standards for school counselors from recognized professional organizations, such as the American School Counselor Association and/or the American Counseling Association. Synthesize principles from the standards to create a personal code of ethics. (TN Reading 1, 8; TN Writing 4, 5, 7, 9)

6) Define confidentiality in the context of school counseling. Synthesize information from local, state, and federal laws and policies to create a list of guidelines under which student counseling records may be released and to whom. Use the guidelines to analyze counseling case studies and assess the extent to which confidentiality requirements were appropriately implemented. (TN Reading 4, 8; TN Writing 4, 7)

School Counseling Models

7) Compare and contrast mental health therapy models/theories and create an informational artifact summarizing the findings. Include key theorists, their therapy philosophies and techniques, and implications for modern counseling practice. Theories to research include but are not limited to:
   a. Behavioral therapy
   b. Cognitive-Behavioral therapy
   c. Person-Centered therapy
   d. Family Systems therapy
   (TN Reading 1, 2, 9; TN Writing 2, 7; TN Psychology 35, 38)

8) Illustrate specific strategies used within the following major domains highlighted by the American School Counselor Association:
   a. Academic
   b. Personal/Social
   c. Career
   (TN Reading 1; TN Writing 8)

9) Working collaboratively, research various models of student-to-student intervention, including but not limited to peer mediation and tutoring. Assess the potential benefits of implementing a peer assistance program within a school and present findings to the class. (TN Reading 1, 2, 8; TN Writing 4, 7, 9)

Counseling Young Children (pre-K to fifth grade)

10) Research the types, indicators, and the legal requirements for reporting child welfare issues. Prepare an informational artifact for different types of issues, describing the common signs and symptoms indicative of abuse, and outline the reporting requirements and procedures at the district and state levels. (TN Reading 7; TN Writing 4, 7, 9; FACS 4)

11) Research circumstances that elementary level guidance counselors may be required to address. Synthesize information gathered into a research paper or project on topics including, but not limited to:
   a. Divorce/remarriage of parents

b. Discipline issues
c. Learning disabilities
d. Career awareness and exploration
e. Education on understanding self and others
f. Peer relationships, coping strategies and effective social skills
g. Transition to middle school
(TN Reading 1, 9; TN Writing 1, 7, 9; TN Psychology 43, 45; TN Sociology 20; FACS 4, 12)

Counseling in Middle School (sixth grade to eighth grade)

12) Research situations that guidance counselors in middle schools may need to address. Synthesize information gathered into a research paper or project on topics including, but not limited to:
   a. Puberty
   b. Discipline issues
   c. Learning disabilities
   d. Bullying
   e. Eating disorders
   f. Academic skills support and planning
   g. Peer relationships and effective social skills
   h. Communication, problem-solving, decision-making and conflict resolution
   i. Career awareness, exploration and planning
   j. Substance abuse education
   k. Individual/family/school crisis intervention
   l. Transition to high school
   (TN Reading 1, 9; TN Writing 1, 7, 9; TN Psychology 43, 45; TN Sociology 20; FACS 4, 12)

Counseling in High School (ninth to 12th grade)

13) Craft an argumentative essay about the strength of peer influence versus parental influence on decision-making among adolescents. Develop claim(s) and counterclaim(s) with reasoning and evidence. (TN Reading 1; TN Writing 1, 9; TN Psychology 45, 47; TN Sociology 20; FACS 4, 6, 12, 13)

14) Research situations that guidance counselors in high schools may need to address. Synthesize information gathered into a research paper or a project based on topics including, but not limited to:
   a. Class scheduling
   b. Popularity
   c. Stress
   d. Peer relationships and effective social skills
   e. Bullying
   f. Sexuality
   g. Pregnancy or other health issues
   h. Truancy and school refusal
   i. Juvenile Justice
   j. Drug and alcohol use
   k. Study and test-taking skills
   l. Postsecondary planning and application process

m. Career planning and awareness
n. Conflict resolution
(TN Reading 1, 9, 10; TN Writing 1, 7, 9; TN Psychology 45, 47; TN Sociology 20; FACS 4)

15) Demonstrate understanding of the Tennessee juvenile justice system by synthesizing information from various reputable sources to describe:
    a. The potential roles and responsibilities of a school counselor
    b. The role of a Court Appointed Special Advocate
    c. The three major circumstances under which a juvenile court decides custody arrangements for juveniles
(TN Reading 2; TN Writing 7; FACS 12)

Emergency Counseling

16) Research tools for assessing self-harm and suicide risk, including depression inventories. Create a chart for analyzing risk level (low, medium, high) based on the following:
    a. Immediate predictors
    b. Psychiatric history
    c. Current life events or situations
    d. Support systems
    e. Emotional or behavioral factors
(TN Reading 7; TN Writing 4; FACS 12)

17) Create an informative artifact explaining the difference between characteristics of grief at preschool, elementary, and secondary school levels and cite evidence for appropriate preliminary interventions. (TN Reading 1, 9; TN Writing 4)

18) Develop grade-appropriate written and illustrated instructional materials, including electronic media (if available), directing students to various resources. Examples of resources include but are not limited to crisis hotlines and social service agencies. (TN Writing 4, 9)

Communication Skills

19) Develop and practice active listening skills including identification of speaker's major points, focusing on speaker's message rather than listener's response, discriminating between fact and opinion, and verifying interpretation of message. Use appropriate note-taking techniques and overcome communication barriers by treating the speaker with courtesy and respect. Seek clarity of reception of communication by responding to verbal messages and other cues such as body language by rephrasing statements and asking questions. (TN Writing 3; FACS 13)

20) Differentiate between verbal and nonverbal communication when interacting with students. List specific techniques for effective communication and evaluate how different cultures attach different meanings to communication techniques. (TN Reading 4, 9; TN Writing 7; TN Sociology 7, 9, 11; FACS 13)

21) Practice communication skills by writing and participating in role play exercises and critiquing the role play exercises of others. Demonstrate specific techniques for building rapport with students, parents, and other stakeholders, including but not limited to:

a. Reflecting without judgment
b. Affirmation
c. Summarizing
d. Asking open-ended questions
e. Empathizing
(TN Writing 4; FACS 13)

22) Cite evidence to support the idea that conflict is a normal part of human relationships at home, school, and work. Compare and contrast communication styles in conflicts. Practice different styles of handling conflicts by participating in role-play exercises and critiquing the role-play exercises of others. (TN Reading 1)

The following artifacts will reside in the student's portfolio:
- History of School Counseling graphic
- Career Investigation artifacts
- Personal Code of Ethics artifacts
- Guidelines for Student Records
- Counseling Model artifacts
- Domain illustrations
- Circumstance Research artifacts
- Emergency Graphic illustrations
- Grief illustration
- Communication artifacts

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.
- TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Teaching as a Profession III (TAP III)

Primary Career Cluster:	Education and Training
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6126
Prerequisite(s):	*Teaching as a Profession II* (6125) or *School Counseling* (6124)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Education and Training courses.
Programs of Study and Sequence:	This is the capstone course in the *Teaching as a Profession, Early Childhood Education,* and *Educational Support Careers* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-education-training

Course Description

Teaching as a Profession III (TAP III) is a capstone course in the Education and Training career cluster for students interested in applying the knowledge and skills learned in previous courses toward becoming a teacher, school counselor, librarian, or speech-language pathologist. The course covers classroom professionalism, ethics, policies, communications, and career requirements in education fields. In addition, students will complete an internship and continue to create artifacts for their student

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portfolios. Upon completion of this course, proficient students will be prepared to pursue advanced training at a postsecondary institution. ~~Standards in this course are aligned with Tennessee State Standards English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Psychology, as well as the National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Work-Based Learning Framework

Internship standards outlined below may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning .The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the capstone course in the *Teaching as a Profession*, *Early Childhood Education,* and *Educational Support Careers* programs of study, providing an opportunity for an internship experience. For more information on the benefits and requirements of implementing these programs in full, please visit the Education and Training website at https://tn.gov/education/article/cte-cluster-education-training.

Course Standards

Professionalism, Ethics, and 21st Century Skills

1) Collaboratively develop a professionalism rubric with performance indicators for each of the following professional attributes:
   a. Attendance/punctuality
   b. Professional dress and behavior
   c. Positive attitude
   d. Collaboration
   e. Honesty
   f. Respect
   g. Responsibility
   h. Appropriate technology use
   i. Reflective teaching practice
   ~~(TN Reading 3; TN Writing 4; FACS 13)~~

2) Analyze the Tennessee Teacher Code of Ethics and compare it to professional ethical standards from recognized educator professional organizations (such as the National Education Association and others) and discuss the purpose of providing specific statements in the code. Research codes of ethics for teachers in specific content areas and special education, where available. Synthesize principles from the standards to create a personal code of ethics. ~~(TN Reading 2, 6, 9; TN Writing 4, 7, 9; FACS 4)~~

Policies

3) Use authentic resources (such as federal or state regulations; local education agency policies) to create a checklist of the circumstances under which grades, records, medical information or other student information may be released and to whom. (TN Reading 1, 2; TN Writing 4, 9)

4) Research and describe the procedure for documenting and reporting child welfare concerns. Analyze a child welfare case study and assess the extent to which the proposed resolution of the case is appropriate. (TN Reading 1, 2, 3, 8; TN Writing 1, 9; FACS 12)

5) Analyze case studies of problematic school situations and assess the degree to which their proposed resolutions are supported by legal and ethical policies. (TN Reading 1, 2, 8)

Requirements for Careers in Education

6) Access electronic resources from the Tennessee Department of Education Office of Teacher Licensing to identify the teacher certification requirements for the state of Tennessee. Prepare a visual representation comparing the educational and licensing requirements for entering and advancing in specific teaching careers (such as preschool, elementary school, middle school, high school). Include the specific requirements for teaching in various content areas. (TN Reading 2, 7; TN Writing 4, 6)

7) Review case studies in education and use findings to develop an argument supporting or opposing the use of background checks for teacher hiring, including fingerprinting, drug testing, and checking professional references. (TN Reading 8; TN Writing 1)

8) Using the Tennessee Educator Acceleration Model (TEAM) – or other appropriate teacher evaluation instrument – investigate the domains and associated indicators of expected teacher behaviors and characteristics. In a coherent narrative, summarize the steps in the educator assessment process and analyze their classroom relevance. (TN Reading 1, 2, 5; TN Writing 2, 4, 7, 9)

Teaching and Learning

9) Using academic journals and scholarly research on effective teaching practices, investigate the impact of teacher content knowledge and pedagogical knowledge on quality of instruction, as measured by student outcomes. Craft an argumentative essay making a claim about the impact of educator background on student outcomes, developing reasoning with evidence from research. (TN Reading 1, 4; TN Writing 1, 4, 7, 9)

10) Identify teaching methods advocated by current learning research and describe appropriate research-based practices at developmental levels from ages 9 to 21, including subject-specific teaching practices. Use this research to assign suitable teaching methods to lesson plans created in the previous course and write recommendations for adaptations needed for students with different learning styles or special needs. (TN Reading 1, 10; TN Writing 2, 4, 5, 8, 9; TN Psychology 38, 70)

11) Build on current understanding of the types and purposes of assessments by creating appropriate assessment tools using examples and findings from current academic research. Write a narrative explaining how assessment results are used for planning instruction. Administer assessments, record results, and provide student and parent feedback. (TN Writing 2, 4)

12) Develop grade-appropriate written and illustrated instructional materials and resources, as well as electronic media (if available), to accompany lesson facilitation during the internships. (TN Writing 4, 6)

Communication

13) Draw conclusions about the relationship between classroom communications and student learning, citing examples from case studies, instructional materials, and academic journals. (TN Reading 7, 9)

14) Develop a communications rubric with performance indicators for effective verbal, non-verbal, written, and electronic communication. Create parent/guardian contact information forms and a draft agenda for parent conferences. Use the rubric to evaluate simulated parent conferences (prior to internships). (TN Writing 4; FACS 13)

Internship

15) Collaboratively, create a rubric that will be used by observers to evaluate preparation for the internship, implementation of lesson plans, and professionalism. (TN Writing 4)

16) During the internship, implement lesson plans developed in a previous course. Annotate accordingly the plans to document the teaching process. (TN Writing 5)

17) Create and continually update a personal teaching journal to document the internship. Draw connections between the experience and course content, thoughtfully reflecting on:
   a. Tasks accomplished and activities implemented
   b. Lesson effectiveness
   c. Positive and negative aspects of the experience
   d. Self-assessment and plans for refining instructional practice
   e. Interactions with students, families, teachers and staff
   f. Personal satisfaction
   (TN Writing 4, 6, 7, 10; FACS 13)

18) Upon conclusion of the internship, write a reflection paper containing a revised personal teaching philosophy and career growth plan based on the teaching journal. Use technology to create a class presentation showcasing highlights, challenges, and lessons learned from the internship. (TN Writing 2, 5, 6, 7)

The following artifacts will reside in the student's portfolio:

- Revised statement of personal teaching philosophy
- Personal code of professional ethics

- Revised career and professional growth plan
- A description of the internship school, student body, and a job description or list of responsibilities
- Lesson plans, assignments, assessment tools and instructional materials created
- Examples of visual materials incorporated (e.g. graphics, presentation slides, videos, demonstrations) into lessons
- Description of instructional technology used, with examples if appropriate
- Daily teaching journal reflecting on tasks and activities, lesson effectiveness, positive and negative aspects of the experience, self-assessment, plans for refining instructional practice, and interactions with students, families, teachers and staff
- Feedback from supervising teacher at site and from TAP III teacher based on observations, using Tennessee Educator Acceleration Model (TEAM) or other state-approved observation rubric

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.
- TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Accounting I

Primary Career Cluster:	Finance
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5910
Prerequisite(s):	*Introduction to Business & Marketing* (5905)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Finance or Business Management & Administration courses.
Programs of Study and Sequence:	This is the second course in the *Business Management, Accounting,* and *Banking and Finance* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org; FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to a local postsecondary institution(s) for more information.
Teacher Endorsement(s):	030, 052, 054, 055, 152, 153, 158, 201, 203, 204, 311, 430, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-finance

Course Description

Accounting I is an essential course for students who wish to pursue careers in business and finance, or for those who wish to develop important skillsets related to financial literacy. Whether students aspire to be future business owners or work in finance with other companies, accounting skills are fundamental to success and applicable in many different fields. In this course, proficient Accounting students develop skills to analyze business transactions, journalize, post, and prepare worksheets and

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financial statements, and apply financial analysis to business processes. Additionally, students receive exposure to the ethical considerations that accounting professionals must face and the standards of practice governing their work, such as the GAAP (generally accepted accounting procedures) standards. Upon completion of this course, proficient students will be prepared to apply their accounting skills in more advanced Business and Finance courses, and ultimately pursue postsecondary training. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts and Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Business Management, Accounting,* and *Banking and Finance* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Finance website at https://tn.gov/education/article/cte-cluster-finance.

Course Standards

Exploration of Accounting Careers

1) Define the role of accounting in business, and compare and contrast the various functions and roles of accountants and bookkeepers. Explain the importance of accounting in both for-profit and non-profit businesses. ~~(TN Reading 1, 4)~~

2) Drawing on research from sources such as the American Institute of Certified Public Accountants (AICPA) and the Bureau of Labor Statistics (BLS), identify the skills needed to succeed in accounting and finance-related fields. Using real-time labor market data, investigate opportunities for job growth in these fields. Take a career interest inventory to assess goals and aptitudes, and develop a career plan based on the results. ~~(TN Reading 1, 4; TN Writing 4, 7, 9)~~

3) Research authentic vacancy announcements for accounting professionals on online job boards or the websites of major companies. Compare interests and skills from the career interest inventory with the requirements listed in job descriptions, such as education credentials and work experience. Based on the research, develop a profile of one such position, detailing what the typical work day, salary, and responsibilities of a chosen accounting professional look like in a given location and/or sector of the financial industry. ~~(TN Reading 2, 6, 9; TN Writing 9)~~

Double-Entry Accounting Process

4) Define the double-entry accounting system. Examine the accounting equation and the rules of debit and credit. Categorize specific accounts (i.e., assets, liabilities, owner's equity, etc.) and analyze the impact of simple transactions on the accounting equation. ~~(TN Reading 1, 4, 5)~~

5) Using the fundamental steps of transaction analysis, demonstrate a thorough understanding of the accounting cycle by performing the following:
    a. Collect and analyze source documents, including invoices, receipts, memorandums, check stubs, and calculator tape
    b. Analyze each transaction
    c. Journalize each transaction and post to ledgers
    d. Prepare a trial balance and work sheet

e. After journalizing, posting, and adjusting, prepare a post-closing trial balance

f. Prepare financial statements (i.e., balance sheet, cash flow statement, income statement, change in equity statement, etc.)

For example, review sample transactions presented either through source documents or in narrative form, then determine what accounts are affected and whether they increase or decrease as a result of the transaction. Classify the accounts as assets, liabilities, or owner's (shareholders) equity, and create journal entries. Students should use both manual and computer based methods to develop accounting solutions in this course. (TN Reading 1, 3, 5; TN Math N-Q)

Analysis of Financial Data

6) Outline the major stages of the merchandising business cycle and review inventory control and payment terms (i.e., just-in-time [JIT] inventory, cash, trade, quantity, seasonal discounts, etc.). While examining the financial records of a business, determine the cost of merchandise inventory and cost of merchandise sold for a given range of products in a specified time period, analyzing the impact on business profitability. For example, perform simple "what if" analysis to determine the range of profitability, based on changing variables of the cost of merchandise sold and merchandise inventory in relationship to operating costs, such as salaries, equipment, supplies, and overhead. (TN Reading 4, 8; TN Math N-Q, A-CED, S-ID)

7) Examine financial statements and analyze the effects of changing revenue and expenses on net income and assets. Identify trends within a company's financial information and compare and contrast present performance to past performance, as well as to industry competitors and overall averages. Evaluate the impact of basic changes in current assets, liabilities, revenues, and net income on liquidity and profitability. For example, an increase in the *cash in bank* account will drive an increase in the current and quick ratios (liquidity) of a company. Based on the analysis, develop business strategies to improve liquidity and profitability. (TN Reading 3, 7, 9; TN Math N-Q, F-IF)

Key Business Processes

8) Explore cash control systems, and evaluate the importance of these systems to the security and stability of a business. Outline and demonstrate the steps for maintaining a checking account, including properly writing checks, tracking the check book balance, and reconciling that balance with the bank statement. Practice journalizing NSF (Not Sufficient Funds) checks, bank fees, and business credit card fees. (TN Reading 3)

9) Compare and contrast different means of paying employees, evaluating which methods provide the best motivation to reach company goals. Establish a complete payroll system, including reviewing various means of tracking hours worked, completing a payroll register, preparing an employee earnings record, and cutting employee checks. Journalize and post for each account affected in the process. (TN Reading 8, 9; TN Writing 4; TN Math N-Q)

10) Use the federal tax tables published by the Internal Revenue Service (IRS) to calculate the correct tax withholding for each employee, justifying the selection. Journalize and post to reflect the payment of the ongoing payroll liabilities, including Federal Income Tax, Social Security and Medicare taxes, Medical Insurance, and any other withholdings. (TN Reading 3, 4, 7; TN Math N-Q)

Ethics and Effective Business Communication

11) Analyze the need for strong ethics in the field of accounting and for ongoing reputable business operations. Determine how GAAP (generally accepted accounting principles) rules serve the business world and create a standard for building and evaluating financial statements. Conduct research on various fraud cases and report on how they were discovered. Submit an analysis on which of the GAAP rules were violated and write persuasively to describe what could have been done to prevent these frauds. ~~(TN Reading 2; TN Writing 1, 8)~~

12) Develop and refine clear verbal and written communication techniques in order to properly describe and explain accounting methods and procedures. Practice narrating such procedures to mock "peer clients" as would a financial service professional, translating technical concepts into everyday language a potential customer could understand. Through small group projects and presentations, gain an understanding of the importance of teamwork and leadership, and model proper interpersonal business behavior needed to establish rapport and trust with clients. ~~(TN Reading 1, 5; TN Writing 2, 5, 7)~~

Mock Accounting Review

13) As part of a collaborative or end-of-course project, conduct a mock accounting review to demonstrate workplace skills required in the profession. Interpret and analyze financial documents to derive accounting solutions. Prepare a glossary of key terms to help explain the recommendations and procedures, citing evidence from financial document analysis. Upon completion of the project, deliver a presentation or create a summary document demonstrating the ability to communicate the accounting process, explaining how procedures and principles were followed to achieve project goals. ~~(TN Reading 3, 4, 5; TN Writing 2, 4, 6)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Statistics.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above~~

~~should be able to demonstrate quantitative, algebraic, functional, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Accounting II

Primary Career Cluster:	Finance
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5911
Prerequisite(s):	*Accounting I* (5910)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Finance.
Programs of Study and Sequence:	This is the third course in the *Accounting* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org; FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to a local postsecondary institution(s) for more information.
Teacher Endorsement(s):	030, 052, 054, 055, 152, 153, 158, 201, 203, 204, 311, 430, 434, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-finance

Course Description

Accounting II is an advanced study of concepts, principles, and techniques used by businesses to maintain electronic and manual financial records. This course expands on content explored in *Accounting I* to cover the accounting processes of a variety of different firms, including merchandising, manufacturing, and service-oriented businesses. Upon completion of this course, proficient students will gain in-depth knowledge of business accounting procedures and their applications to business operations. Upon completion of this course, students will be prepared for postsecondary study and advanced training in accounting or business. Additionally, completion of this course can lead to a work-

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based learning (WBL) experience as the program of study capstone. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts and Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the third course in the *Accounting* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Finance website at https://tn.gov/education/article/cte-cluster-finance.

Course Standards

Accounting Processes and Operations

1) Demonstrate a thorough understanding of the accounting cycles of merchandising, manufacturing, and service businesses while performing actions necessary to plan, control, and evaluate business operations. Differentiate between inventory for both merchandising and manufacturing businesses and explain how the different types of businesses apply appropriate valuation methods when preparing financial statements. ~~(TN Reading 2, 3)~~

Collection and Recording

2) Collect source documents used to track transactions in accounting processes, such as invoices, receipts, memorandums, check stubs, deposit slips, and electronic records. Describe the process used by a merchandising business to prepare, review, and analyze source documents as part of the accounting cycle, citing evidence from sample documents. ~~(TN Reading 1, 4; TN Writing 4, 9; TN Math N-Q)~~

3) Maintain accurate and balanced records for all accounts analyzed throughout the duration of the course. Analyze source documents of increasing complexity within a variety of merchandising, manufacturing, and service operations. For a given transaction, determine debits and credits; journalize transactions in the general journal or special journals; post to the general ledger and subsidiary ledger accounts; and determine the ending balances of each account. ~~(TN Reading 1, 9; TN Math N-Q)~~

Finalization and Analysis of Data

4) Gather sample accounting worksheets from public records, textbooks, or other company templates to determine how merchandising businesses prepare financial records. Drawing on this information, prepare an original 10 column worksheet. Define and provide examples of key categories and terms, including accounts receivable, accounts payable, and various tax accounts. ~~(TN Reading 2, 3, 4; TN Math N-Q)~~

5) Demonstrate accurate analysis of financial data by performing the following processes:
   a. Record and post adjusting entries to affected supplies, inventory, notes receivable, insurance, accounts payable, and tax accounts
   b. Prepare and analyze financial statements

      c.   Record closing entries of temporary accounts, including revenue, expense, and withdrawals accounts

      d.   Prepare the post-closing trial balance

For example, starting with a file of source documents and financial statements from the prior time period, complete a simulation or a mini-project spanning all steps in the accounting cycle for a merchandising business. (TN Reading 3, 4, 7; TN Math N-Q)

Accounting Applications and Implications

6) Compare and contrast the cost accounting records for a merchandising business with a manufacturing business.

      a.   For a merchandising business, analyze the means of tracking and accounting for physical inventory and determining the actual cost of the merchandise resold to customers. Calculate the ending balance of the inventory account using the adjustment process

      b.   In a manufacturing business, review the components of systems used to maintain records of manufacturing costs. Differentiate between job order and process cost accounting, and demonstrate an understanding of the advantages of each system for different manufacturing processes. Track the flow of inventory in the product process, from raw materials to work-in-process to finished goods inventory

      c.   For both businesses, account for direct labor, direct material, and factory overhead budgeting

For example, schedule a real or virtual field trip to a local manufacturing plant to observe how raw materials are converted to finished goods. Upon completion of the tour, prepare an informational text and accompanying graphic illustrating the cost accounting methods and budgeting practices employed by the firm. (TN Reading 6, 7; TN Writing 2; TN Math N-Q)

7) Analyze budgetary planning and controls for the financial operation of a merchandising, manufacturing, or service business. Perform analysis typical of an accounts manager by comparing actual amounts of revenues, expenses, and cash with budgeted amounts. Develop a written narrative, complete with supporting financial statements, to illustrate how businesses use this type of financial information to make management decisions. (TN Reading 5, 7, 8; TN Writing 2, 8; TN Math N-Q)

8) Illustrate how accounting information facilitates management decision making. For example, determine the factors that businesses must consider when making the following decisions: make or buy a product; lease or buy an asset; discontinue a department, plant, or product; offer discounted prices on special orders; replace and repair equipment. (TN Reading 1, 9; TN Writing 4; TN Math N-Q, F-IF)

9) Examine various advanced applications of accounting for a merchandising business, and analyze the implications that each has for the business's profitability. Advanced applications include, but are not limited to, the following:

      a.   Prepare adjustments for uncollectible accounts using both the direct write-off and the allowance method

      b.   Analyze methods related to assigning cost to inventory, including the specific identification method, first-in first-out (FIFO) method, last-in first-out (LIFO) method, and weighted average cost method

For example, calculate the cost of a business's inventory using all four inventory valuation methods and determine the effect on financial statements. (TN Reading 1, 3, 9; TN Math N-Q, A-CED)

10) Define depreciation in accounting contexts, and determine the impact of depreciation on a variety of goods in different industries (i.e., manufacturing, agriculture, retail services, and more). For a selected firm in one of these industries, analyze and journalize acquisition, depreciation, and disposal of a plant asset, then calculate depreciation using the straight-line, declining balance, and sum-of-the-years digits methods. (TN Reading 1, 2; TN Math N-Q, A-CED)

Accounting in a Business Startup and Expansion

11) Research IRS.gov for multiple small business and self-employment forms/publications detailing important tax information related to the various stages of owning a business, from starting and filing for an Employer Identification Number (EIN), to operating and closing. Follow procedures to complete sample federal income tax employment/payroll forms (i.e., 940, 941, 944, W2) for small businesses, including social security and Medicare taxes, FUTA, and self-employment taxes. Prepare quarterly and end-of-tax-year examples for a real or fictitious small business. (TN Reading 3, 4; TN Math N-Q)

12) Examine the steps required to form and expand a partnership. Analyze the transactions necessary for forming a partnership, admitting new partners, and distributing net income among partners, including identification of federal income tax forms for partnerships. (TN Reading 1, 2)

13) Investigate the process for incorporating a business. Accurately analyze practices and business forms related to the start-up of a corporation, including but not limited to stock subscriptions, dividends declaration, dividend payment, capital acquisition, and treasury stock. Include in the examination income tax filing requirements for corporations and note SEC (U.S. Securities and Exchange Commission) requirements for expansion of existing stocks in the process. Prepare an argumentative text intended for a simulated business which affirms the advantages of incorporating versus remaining a sole proprietorship or partnership. (TN Reading 1, 2, 9; TN Writing 1, 8)

Business Ethics

14) Investigate codes of ethics from professional organizations in accounting, personal finance, and banking and GAAP (Generally Accepted Accounting Principles) and examine areas of commonality. Synthesize principles from the codes investigated including separation of duties to create a personal code of ethics. (TN Reading 1, 2; TN Writing 4, 7, 9)

15) Examine real-world situations that involve ethical dilemmas and the application of correct professional conduct as highlighted in recent news articles. Craft an argumentative essay making a claim about the importance of ethics and professional standards for persons working in the accounting pathway, citing examples from case studies to argue for the relevance of professional codes of conduct. (TN Reading 2; TN Writing 1, 4, 9)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Banking and Finance

Primary Career Cluster:	Finance
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5899
Prerequisite(s):	*Accounting I* (5910)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	None
Programs of Study and Sequence:	This is the third course in the *Banking and Finance* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org; FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are currently dual credit opportunities with specific colleges, including Nashville State Community College.
Teacher Endorsement(s):	030, 033, 035, 039, 052, 054, 152, 153, 158, 201, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-finance

Course Description

Banking and Finance is designed to challenge students with real-world banking and financial situations through a partnership with a local financial institution. This business partnership should provide resources for faculty and students that include but are not limited to mentors, seminars, and hands-on experience with day-to-day banking operations. Upon completion of this course, proficient students will have a strong foundation for continued education in finance and business administration, specializing in occupations that support banking and financial institutions. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the third course in the *Banking and Finance* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Finance website at https://tn.gov/education/article/cte-cluster-finance.

Course Standards

Introduction to Banking

1) Define the term *financial institution*. Compare and contrast the types of financial institutions (e.g., commercial banks, credit unions, savings and loans institutions, money center banks) and their major functions, services, and roles with the U.S. banking system; explain their impact on the economy and individual communities. (TN Reading 2, 4, 9; TN Writing 4, 9)

2) Investigate the origins and purpose of banking. Explore the history of banking systems from ancient to modern times, evaluating models, milestone events, court decisions, and legislation that contributed to the system used by the United States today. Develop a timeline of major milestones in U.S. banking history. Prepare a presentation on one milestone event to illustrate its impact on banking, citing textual evidence to support the facts in the presentation. (TN Reading 1; TN Writing 7, 9)

Money

3) Identify the characteristics and functions of money as well as the measures used by the Federal Reserve to calculate the money supply. Describe how money is created, valued, and exchanged. Using data from textbook(s) and/or industry publications and media, research and explain how banks make money focusing on the role of savers and borrowers, interest, and the fractional reserve system, citing evidence from the text. (TN Reading 1, 5, 9; TN Writing 2, 4, 8, 9)

4) Articulate the purpose, functions, and organization of the Federal Reserve System by describing its structure, including the role of the Board of Governors and Reserve Bank Districts and branches. Identify the Reserve Banks and branches that serve communities in Tennessee and explain how members of the Board of Governors are selected. (TN Reading 2; TN Writing 2, 4, 9)

5) Prepare an informative narrative explaining the chief objectives of American monetary policy, citing specific textual evidence to support analysis. Describe how the Federal Reserve maintains stability of the U.S. financial system by targeting and managing monetary policy. (TN Reading 1, 2; TN Writing 2, 4)

Banking Regulations and Consumer Protection

6) Research and report on legislation and regulatory changes that have affected financial services and products in the U.S., including the Depository Institutions Deregulation and Monetary Control Act of 1980; Gramm-Leach-Bliley Act (also known as the Financial Services Modernization Act of 1999); the Check Clearing for the 21st Century Act (also known as Check21); and Reserve Requirements. (TN Reading 2; TN Writing 7)

7) Identify and describe significant legislation and policies associated with credit and consumer protection, including Federal Deposit Insurance Corporation and National Credit Union Association Deposit Insurance Limits; Credit Card Accountability, Responsibility, and Disclosure Act of 2009; the Dodd-Frank Wall Street Reform and Consumer Protection Act; the Truth in Lending Act; and, the Fair and Accurate Credit Transactions Act. (TN Reading 2, 4; TN Writing 9)

8) Investigate banking rules and regulations; research and describe the relationship between local banks and their regulators (e.g., Federal Deposit Insurance Corporation, Office of the Comptroller of the Currency, Federal Reserve, National Credit Union Administration, Tennessee Department of Financial Institutions, Consumer Financial Protection Bureau) and how each contributes to stability in the financial markets, reinforces public confidence in the banking system, and compliance with applicable laws. (TN Reading 1, 5; TN Writing 4, 9)

Financial Services and Products

9) Research financial services and products available across the financial services industry then compare and contrast the benefits and costs of common deposit accounts as well as other products and services, including investment tools. Given a scenario, craft an argumentative essay supported by evidence about selecting a specific financial account or service that will best meet the need of a prospective customer. (TN Reading 1, 9; TN Writing 1, 4, 6, 7, 9)

10) Investigate technological advances that have impacted the financial services industry. Working in student groups, prepare an informative presentation for community members about the evolving landscape of e-banking, including security and efficiency considerations. (TN Reading 2, 9; TN Writing 4, 8, 9)

11) Simulate or conduct procedures for student and teacher or mock customers. Prepare financial statements and determine efficient and confidential means of distributing statements, ranging from e-banking options to in-person transactions. Demonstrate proficiency in performing account reconciliation. Using a spreadsheet, perform and analyze the compound interest function. (TN Reading 3; TN Writing 4, 6; TN Math N-Q, A-CED, A-SSE, F-IF)

Credit

12) Explore the concept of credit and articulate the importance of the credit function to society. Working in groups, debate the advantages and disadvantages of credit by crafting claim(s) and counterclaim(s), citing specific textual evidence from news media, professional analyses and scholarly commentary. (TN Reading 1; TN Writing 1, 9)

13) Explore credit and lending functions and products available from both traditional and nontraditional (e.g., payday loan) lenders. Compare and contrast the types of loans commonly available to consumers. Assess credit options as they relate to loan applications and design an electronic spreadsheet or utilize an online credit calculator for calculating the cost of credit options. Demonstrate the entire loan process from customer inquiry through funding, including the evaluation of risk, debt to loan ratio, and payment delinquencies. (TN Reading 2, 3, 4, 6, 9; TN Writing 4, 9; TN Math N-Q, A-CED, A-SSE)

14) Citing information from at least one of the three major credit reporting agencies, describe credit reports and credit scores; explain the impact of credit history on a customer's ability to secure credit, identifying key factors that influence one's credit score, such as paying bills on time. Analyze a sample credit report; interpret how the contents may affect a borrower's credit score, borrowing opportunities, and cost of credit; and, evaluate the credit risk to the financial institution. Role-play the part of a bank credit counselor in a scenario instructing a denied applicant ways to improve his or her credit score. (TN Reading 1, 8, 9; TN Writing 4, 9; TN Math N-Q)

Bank Management, Policies, and Procedures

15) Research the management and operations structure of a financial institution. Identify key banking positions such as branch managers, compliance officers, loan officers, finance managers, wealth advisors, and financial services specialists and describe their primary functions and responsibilities. Examine financial institution policies and procedures. Draft policies and procedures governing the day-to-day operations of a school-based or simulated financial institution based on the policies and procedures research and a survey of student body requests. Determine profit objectives and roles of employees (students) in the financial institution. (TN Reading 2; TN Writing 4, 9)

16) Explore the role of customer service in the financial services industry. Explain in a written narrative the impact of effective customer relations, including the importance of developing relationships, building rapport and trust, matching products and services to a customer's needs, and maintaining customer confidentiality. Provide examples of positive customer service through role-play activities with fellow classmates. (TN Reading 2, 4; TN Writing 2, 9)

17) Through a school-based financial institution, role-play situation, or student organization competitive event, conduct banking operations or simulate scenarios to demonstrate mastery of critical thinking, customer service, effective communication, security measures, and related employability skills that are considered essential workplace behaviors in the banking industry. Research workplace issues that may jeopardize customer privacy and confidentiality. Write an informative narrative explaining the importance of ethics and the fiduciary duty between banking professionals and their customers. (TN Reading 2; TN Writing 2, 4, 9)

Marketing Strategies Used by Financial Institutions

18) Identify specific marketing segments for financial institutions; select a banking product and determine whether mass or targeted marketing strategies would be most effective in reaching the product's intended customers. Conduct an analysis of multiple case studies to draw conclusions and justify the strategic decision in writing. Develop a marketing presentation targeted at students and teachers related to the school-based or simulated financial institution and/or a specific product/service it offers. (TN Reading 4, 6, 9; TN Writing 2, 4, 6)

19) Analyze the impact of competition among financial institutions in the local community; identify the competitive advantages and disadvantages of products and services offered and make recommendations for a shift in marketing strategies, message, and/or pricing based on the research and observations. (TN Writing 2, 7)

Financial Industry Career Options
The following can be undertaken in a school-based financial institution, a worksite learning experience, or through simulations of either.

20) Evaluate the diverse careers in banking and finance, including bank managers, loan officers, investment bankers, private client advisors, and similar positions. Complete a career interest inventory and use online resources such as the Bureau of Labor Statistics Occupational Outlook Handbook, Jobs4TN, and the websites of financial institutions, regulators, and/or other related organizations to research employment opportunities. Based on interests and skills, identify relevant careers and determine the educational, experience, and licensure/credentialing requirements. (TN Reading 2, 9; TN Writing 7, 9)

21) Conduct a job search or simulate the experience by researching employment options. Prepare a resume suited for employment searches in the banking industry. Participate in a mock interview with a financial institution, human resources department and/or through participation in student organization competitive events. Participate in job shadowing, internships, and/or career events at a financial institution or other related organization. Keep a journal documenting major worksite experiences and write a letter of thanks to the businesses upon completion of work-based learning experiences. (TN Reading 7; TN Writing 4)

22) Explore expectations of working in the financial services industry. Participate in face-to-face presentations or videoconferences with financial industry guest speakers to better understand real-world banking operations, employer expectations, and insight into careers in the industry. Construct interview questions to pose to industry guests. In groups, review the employee handbook of a financial institution. Identify additional expectations and draft an employee handbook for a school-based or simulated financial institution. Adopt the elements of the school-based or simulated financial institution handbook by class consensus. (TN Reading 6; TN Writing 4)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions.

- o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Financial Planning

Primary Career Cluster:	Finance
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5890
Prerequisite(s):	*Personal Finance* (5901), *Accounting I* (5910)*,* and *Banking and Finance* (5899)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Finance courses.
Programs of Study and Sequence:	This is the capstone course in the *Banking and Finance* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org; FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	030, 033, 035, 039, 052, 054, 152, 153, 158, 201, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-finance

Course Description

Financial Planning is the capstone course in the *Banking and Finance* program of study intended for students interested in advanced analysis of financial decision-making and wealth management. In this course, students will delve into advanced concepts related to saving, investment, taxation, and retirement planning, and will be responsible for compiling original portfolios of investment and retirement options to present to mock prospective clients. In addition, students will learn to critique the financial consultations of others based on ethical and legal considerations. Upon completion of this

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course, proficient students will be prepared to pursue advanced study of financial planning, wealth accumulation and management, and market analysis at a postsecondary institution. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts and Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the capstone course in the *Banking and Finance* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Finance website at https://tn.gov/education/article/cte-cluster-finance.

Course Standards

Careers in Financial Planning

1) Define financial planning as an activity performed by wage earners and investors, as well as a profession. Identify the key components of financial planning and explain why it is critical for future financial stability for individuals and families, in addition to the fact that saving and investing are essential to economic growth. ~~(TN Reading 2)~~

2) Compare and contrast the various types of financial planners and the products and services they provide. By reviewing job descriptions, identify the skills needed to succeed in the field and detail the future career opportunities. Participate in a mock interview as though applying to a financial institution or firm. Prior to the interview, research tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Upon completion of the interview, write a formal thank you letter to the interviewer in a written or email format. ~~(TN Reading 9; TN Writing 4)~~

Saving, Investments, and Portfolio Theory

3) Compare and contrast strategies of saving and investing, with saving being an important initial step that contributes to building the capital required for investment. Draw conclusions about the saving rate over time for U.S. households and the flow of funds into mutual funds and other popular investment vehicles, citing evidence from research. Investigate key trends in U.S. saving compared to spending as a percentage of disposable income and develop an argument to present to potential clients highlighting the importance of saving. ~~(TN Reading 1, 5; TN Writing 1, 4, 7, 8)~~

4) Analyze the major categories of investment options and determine the levels of risk and potential return on investment of each. Utilizing investment websites or documents, research the past performance of each category and create a comparison table. Determine which investments have inverse performance characteristics, and analyze which investments perform best in expansionary and recessionary economic periods. ~~(TN Reading 4, 7, 8; TN Writing 7; TN Math N-Q, S-ID)~~

5) Explain the investment concept of diversification, including the aspect of minimizing risk and delivering more consistent returns. Create a role play or other communications device to

emphasize the benefits and promote the use of diversified portfolios by investors, developing claim(s) and counterclaim(s) with evidence and data. (TN Reading 1, 4; TN Writing 1, 6)

6) Evaluate the tradeoffs involved in the suggested portfolios of individuals and families for different stages of life (young, raising children, preparing for retirement, retired). Create a project illustrating students in their lives now and in future years, matched with appropriate portfolios for each stage. Develop a plan for personal and family financial security based on investing sufficient funds in order to generate necessary retirement cash flow. The plan must apply financial formulas and functions to project the future value of investments using annual growth rates. (TN Reading 7, 8, 9; TN Writing 7, 8; TN Math F-IF, F-BF, F-LE)

Impact of Taxation on Investments

7) Describe how the interest, dividends, and growth of various investments are taxed and how taxation affects investment growth and overall returns. Explain the impact of the capital gains tax on investment decisions. Investigate ways that federal and state laws allow individuals, couples, and families to reduce or defer investment taxes, including gifting and charitable donations; and investigate incentive programs like educational and retirement plans, including 529s, Education Savings Accounts, Individual Retirement Accounts, and 401(k)/403(b) accounts. (TN Reading 4, 9; TN Writing 7; TN Math N-Q)

8) Explore the differences between tax-deferred and tax-free investments. Differentiate between plans which are "pre-tax" and "after tax" and create a growth table with accompanying written explanations to demonstrate the net cash flow each will deliver after retirement. (TN Reading 7; TN Writing 9; TN Math N-Q)

Retirement Planning

9) Research the Social Security system and create a cash flow diagram to demonstrate how today's employee contributions are necessary to pay today's retirees. Research current issues associated with the Social Security system and its long-term sustainability, including proposed policy changes to this system. Write persuasively about the current system or proposed legislation and whether it stands to benefit or hurt individuals and the economy, citing evidence from studies, media commentary, and other analyses. (TN Reading 1, 4, 9; TN Writing 1, 7, 8, 9; TN Math N-Q)

10) Determine the options for drawing Social Security retirement funds at various ages. Assess the consequences of initiating payments at the earliest possible ages, taking into account projected constraints such as cost of living, medical expenses, and inflation rates. (TN Reading 9)

11) Calculate the compound growth of investments and identify the importance of beginning early with an investment plan to cover retirement needs. Examine various vehicles created for retirement investments, including 401(k) and 403(b) plans, IRA and Roth IRA, and defined benefit pension plans. (TN Reading 3, 4; TN Math N-Q)

12) Develop and defend a retirement plan for a mock client, including a combination of investment options, and estimate the annual retirement cash flow it may deliver. Justify the choice of investment options and other financial decisions by citing evidence of their projected growth or

success. With peers, critique each other's plans on the merits of their coherence, quality of research into investment options, strategies for safeguarding against untenable risk, and accuracy of financial calculations and projections and revise plans to address critiques. (TN Reading 1, 3, 6, 8; TN Writing 1, 4, 5; TN Math N-Q)

Legal Documents and Ethics

13) Define and interpret the importance of documents and processes related to the end of life, including wills, living wills, power of attorney, medical power of attorney, probate, and estates. Compare and contrast the process of dissolving an estate of a person with a will versus one who died intestate (without a will). Research federal and state laws concerning the taxation of estates and identify situations in which these taxes could present significant challenges to those without proper estate planning. (TN Reading 1, 2, 4, 9; TN Writing 7, 9)

14) Analyze the need for strong ethics in the field of financial planning; report on the ways consumers can determine the history and reputation of professionals in the financial planning field. Research case studies and news reports on investment companies engaging in ethically questionable behavior, and describe the significant impact on many individual investors. Determine the legal protections entitled to individual investors and the processes outlined for seeking restitution. (TN Reading 1, 4, 9; TN Writing 7, 9)

15) Describe the practice of insider trading and research recent cases in which violators have been identified and prosecuted. In a persuasive presentation or project, explain the benefits of compliance with government taxation authorities, and compare with the consequences associated with illegal buying and selling of investments, tax evasion, and other unethical behaviors. (TN Reading 2; TN Writing 1, 7)

Analysis and Communications

16) Develop and refine clear verbal and written communication techniques in order to properly describe and explain key concepts in financial planning. Through small group projects and presentations, gain an understanding of the importance of teamwork and leadership.

17) Conduct reviews of sample portfolios and net worth scenarios and provide an evaluation culminating with a plan of action for adjustments required to maximize overall return and minimize risk in the future. Present an in-depth review of one such portfolio to the class, explaining how the analyses were conducted and risk/return were calculated. Prepare a glossary of key terms to help explain the recommendations and procedures. (TN Reading 1, 3, 8, 9; TN Writing 2, 4, 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee Standards for Mathematics; Math Standards for High School: Number and Quantity, Functions, Statistics.~~
  - o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, functional, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Career Exploration

Primary Career Cluster:	CTE Interdisciplinary
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6166
Prerequisite(s):	None
Credit:	½ - 1*
Grade Level:	8 – 9
Graduation Requirements:	This course is meant to serve as an exploratory course to assist students in determining an appropriate elective focus. It does not fulfill any graduation requirements.
Programs of Study and Sequence:	This course is encouraged as a pre-requisite for any and all high school CTE courses and programs of study, as well as academic and fine art elective focuses.
Aligned Student Organization(s):	None
Coordinating Work-Based Learning:	Teachers must comply with the requirements of the state board's WBL Framework and the Department's WBL Policy Guide and are encouraged to use embedded WBL activities to facilitate career exploration and skill development for students. For information, visit http://tn.gov/education/topic/work-based-learning .
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course.
Teacher Endorsement(s):	001, 004, 006, 007, 009, 009, 010, 011, 012, 013, 014, 015, 016, 017, 018, 019, 020, 021, 022, 023, 024, 025, 026, 027, 027, 028, 029, 030, 031, 032, 033, 034, 035, 036, 037, 038, 039, 040, 041, 042, 043, 044, 045, 046, 047,048, 049, 050, 051, 052, 054, 055, 056, 057, 058, 059, 060, 061, 062, 063, 064, 065, 066, 067, 068, 069, 070, 071, 072, 073, 077, 078, 079, 080, 081, 082, 099, 100, 101, 102, 103, 105, 108, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 145, 146, 125, 126, 127, 128, 129, 130, 131, 132, 133, 147, 150, 151, 152, 153, 154, 155, 156, 157, 158, 201, 202, 203, 204, 210, 211, 212, 213, 214, 220, 221, 230, 231, 240, 241, 250, 301, 310, 311, 400, 401, 402, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 434, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 439, 445, 448, 449, 450, 451, 452, 453, 458, 460, 461, 462, 463, 464,

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Required Teacher Certifications/Training:	None
Teacher Resources:	http://tn.gov/education/article/cte-cluster-middle-school-cte-coursework

Course Description

Career Exploration is an introductory course designed to assist students in (a) discovering their personal strengths and abilities, (b) understanding opportunities available to them in different career areas, and (c) practicing skills necessary to excel in the workforce and in postsecondary learning. Upon completion of this course, proficient students will know and exhibit soft skills (e.g. teamwork, creative thinking, and problem solving), as well as more technical skills (e.g. resume building and written communications) related to career exploration and experience. Students will also learn about and be exposed to existing CTE pathways and elective focus options within a high school setting and will learn how to successfully transition into a district recognized career academy or program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.~~**

Program of Study Application

This course is meant to serve as a middle school or freshman orientation course to available career and technical education (CTE) courses and programs of study and elective focus options. While not required, it is encouraged to be used, where needed, to orient students to available options, while also developing important 21st Century Skills noted by employers and postsecondary institutions alike as important for student success after high school.

This course can serve as a prerequisite for any CTE course and program of study; however, it is not a required part of any programs of study. Due to this, the course should not be counted toward CTE concentrator status.

Course Standards

Personal Assessment and Goal Development

1. Summarize the results of multiple available personal assessment tools (such as, but not limited to instruments determining: interests and aptitudes, personality traits, learning styles, career choice alignments, personal values, etc.) to develop a personal profile and reflect thoughtfully on the results. Ensure summaries cite specific textual evidence from the results and compare and contrast results with prior knowledge or opinions. Throughout the course, continue to refer

back to the results of the profile to connect individual strengths and interests with goal setting, planning, and projects. (TN Reading 1, 2, 9; TN Writing 9)

2. Write, monitor, and revise long-term (over 5 years), mid-term (1 - 5 years), and short-term (a year or less) personal goals, defining desired personal, education, career, and earning milestones in each set – working to learn and define relevant key terms where appropriate. Evaluate factors that may influence these goals, including family responsibilities and personal profile results, individual values, and economic conditions. (TN Reading 4; TN Writing 4)

3. Comparing information in personal profile and desired short-, mid-, and long-term goals, identify areas where support and development may be needed and create (and continue to build throughout the course) a personal toolkit of multiple available resources (physical and digital) to assist with educational achievement, personal growth and development, and career advancement. Vet resources for the toolkit by assessing the extent to which each resource addresses a particular claim or recommendation for addressing a challenge or problem. (TN Reading 8; TN Writing 8)

Academic Achievement

4. Using information about personal learning style and/or personality traits, research and select appropriate study habits, organizational strategies, stress reduction, and time management tactics to improve personal academic achievement and future career success. Test hypothesis about appropriate strategies by following steps to techniques and tools precisely and provide updates (via oral report, teacher-student check-in meetings, or personal reflection journal) about how the techniques did or did not improve achievement. (TN Reading 3, 9; TN Writing 10)

5. Conduct a research project, citing multiple sources, to analyze and describe how skills learned in school (including academic, technical, and "soft skills") benefit an individual in postsecondary training, career, and society. Articulate importance of specific skills that will be focus of high school, including literacy, numeracy, critical thinking and problem solving. (TN Reading 2, TN Writing 7)

6. Research and articulate, in an informative essay, the importance of honesty and integrity in academics and career by describing appropriate and non-appropriate practices in topics such as writing/plagiarism, internet security, identity theft, workplace ethics, and interpersonal relationships/bullying. Using case-studies or comparing and contrasting situational results, identify and practice (throughout the course) appropriate personal practices and strategies. (TN Writing 2)

7. Demonstrate appropriate communication at various levels. Develop and practice active listening skills and effective oral and written communications, appropriate to task and audience, to overcome communication barriers. Demonstrate effective note-taking strategies to summarize main points and speaker/author meanings from multiple sources such as lectures, journals, websites, and/or textbooks/manuals. Address the class using a public-speaking activity. (TN Reading 2, 5; TN Writing 4).

Qualities for Success

8. Analyze and describe how interpersonal and leadership skills (such as respecting differences within groups, personal responsibility, and articulating a clear vision) are necessary to maintain quality relationships and success in postsecondary training and the workplace. Identify, develop, and practice specific skills through team projects in the course.

9. Research and demonstrate understanding of characteristics and tactics for handling difficult conversations, resolving conflict, and giving and receiving constructive criticism.

High School, Postsecondary, and Career Planning

10. Explore available course options for high school elective focus and/or CTE program of study using available resources (such as high school catalog, academy marketing materials, interviews with teachers and/or upperclassmen students, CollegeForTN.gov planning tools, etc.). Include information about potential early postsecondary (dual credit, dual enrollment, CLEP, AP, IB, Cambridge, etc.) and work-based learning (practicum course, internship, school-based enterprise, co-op, etc.) opportunities in addition to extracurricular opportunities (Career and Technical Student Organizations, sporting teams, service organizations, academy activities, fine arts organizations, etc.). Using results of personal profile and mid- and long-term personal goals, identify potential pathways to continue to explore throughout the course. (TN Writing 7)

11. Explore available occupations and career fields using a variety of available sources, such as print, online, interviews with business representatives, job shadowing, tours, guest speakers, career fairs, videos, and simulated work activities/products. Compare results of research to available career opportunities in the local community or region using local job postings, newspapers, and local occupational outlook data. Select a few specific careers to continue to explore throughout the remainder of the course. (TN Reading 9; TN Writing 7, 8, 9)

12. Develop a chart, table, or graphic to compare characteristics of chosen careers, such as alignment to personal interest and aptitude, education requirements, available positions, salaries, potential lifetime earnings, and employer benefits. Research and report (orally, digitally, or in an explanatory text) the requirements for admission to, and related costs of attending, a specific postsecondary institution and how attending that institution will support education, career, and earning goals. (TN Reading 2, 3, 7; TN Writing 2, 6).

13. Using results of personal profile, high school course option research, and career exploration research, update short-, mid-, and long-term goals in order to create both a four-year high school plan and a long-term (i.e. 10-year) career plan. Make a claim about why the chosen plans are appropriate, citing evidence from previous readings and projects to develop and support the claim. Create a profile on CollegeForTN.org (or district-approved alternative resource) and use it to assist in developing and finding supporting resources for plan development. (TN Writing 4)

Experiential Learning*

14. Using personal profile and career plan goals, prepare customized career preparation materials or exercises for a specific occupation or industry, such as:
    a. Resume
    b. Cover letter(s)
    c. Thank you notes (after interviews) to potential employers
    d. List of transferable skills
    e. Job application(s)
    f. Mock interview or role-play exercise
    (TN Writing 4)

15. In a team, research, identify, and apply the steps of the problem solving process (problem identification, brainstorming, evaluating, solution selection, monitoring and revising) in a contextualized situation to determine a solution to a work-related problem presented from a specific career cluster area. Write a proposal outlining and justifying your team's decision or solution. (TN Reading 3, TN Writing 1)

16. Work in a team, with identified roles and responsibilities, to develop a content-area specific work product (such as designing a product or developing an advertisement). Create a flowchart or some type of graphic organizer to illustrate processes taken to accomplish the task. Execute the plan of the product by designing, organizing, creating, reflecting, maintaining, and updating processes and team member responsibilities as needed. (TN Reading 7; TN Writing 5, 6)
    a. Demonstrate the ability to follow safety procedures proficiently as appropriate for the given subject matter. (TN Reading 3)

17. Apply specific mathematics and numeracy concepts to real-world workplace scenarios and projects to demonstrate understanding and transferability of appropriate grade-level mathematics skills. For example:
    a. Comparing and contrasting pay earned by different workers using algebraic thinking.
    b. Ordering, measuring, and storing job supplies and materials using functions.
    c. Determining interest on a loan by exploring a graph of the repayment terms.
    d. Determining an appropriate quantity or cost of a project or set of items by comparing different functions and calculating accurately.

18. Apply communications and literacy skills to real-world workplace scenarios and projects to demonstrate understanding and transferability of appropriate grade-level communications skills. For example:
    a. Research a particular historical figure important to a given field or occupation and craft an informative essay outlining his/her contribution. (TN Writing 2)
    b. Read a case-study about an ethical dilemma in a workplace (such as plagiarism) and craft an argumentative essay that develops and supports a claim about a potential solution to the challenge posed in the case-study. (TN Writing 1)

     c.   Evaluate a piece of marketing material and analyze the publisher's purpose in using the language, structure, and symbols therein. ~~(TN Reading 6)~~

     d.   Select and apply the correct communications tool/technology for a given workplace or academic situation (such as writing a memo relating to the ordering of supplies). ~~(TN Writing 6)~~

     e.   Develop and present a speech to a public audience (such as students in a particular program of study or a panel of industry guests) on a topic specific to a desired occupation or industry.

19. Participate in, and document, a service project that will be presented to the school and/or the community. Investigate a need in the community, conduct interviews, ask clarifying questions to determine specifics, create an innovative way to address the need, document research and proposed solution, and present proposal using effective oral and written communications skills. ~~(TN Reading 2, 7, 8; TN Writing 7, 8)~~

* Experiential Learning should be customized to the needs of the students in a particular district and school. Mastery of all Experiential Learning standards are not required for the successful completion of the course. For example, 9th grade students may create and participate in job-search activities (standard 14), though it may not be appropriate for 8th graders. If this course in being used as a 9th grade career academy or freshman orientation course, specific academy or career cluster projects, in a project-based learning format, may be used to meet the objectives of orienting students to available CTE pathways (standards 15-19). If this course is being offered as a ½ credit course, the Experiential Learning standards are optional.

Standards Alignment Notes

**References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12.~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12.~~
    - ~~Note: While not directly aligned to one specific standard, teachers who are encouraging consistent writing and revising of work products should have students who are able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Materials and References

- CollegeForTN.org: https://secure.collegefortn.org/
- ACT College Readiness Guides: http://www.act.org/standard/guides/act/
- Tennessee *Drive to 55* Reports and Jobs Forecast Tools: http://www.driveto55.org/reports/
- Junior Achievement: Role of Common Core Standards in College and Career Readiness Education https://www.juniorachievement.org/documents/20009/35541/The+Roll+of+Common+Core+Standards.pdf/274c78bd-2dd4-407f-9050-78243ef836e9
- National Association of State Directors of CTE http://www.doe.k12.de.us/commoncore/careerteched/files/CCTC_Standards_Formatted_7_13.pdf

Work-Based Learning: Career Practicum

Work-Based Learning Framework:	The Work-Based Learning Framework establishes the requirements for all Work-Based Learning experiences, whether offered for credit or not. The Work-Based Learning Framework is established in the Tennessee State Board of Education High School Policy 2.103.
Executive Director:	Chelsea Parker, (615) 741-2197, Chelsea.Parker@tn.gov
Course Code:	6105
Capstone:	This course is considered a work-based learning (WBL) capstone experience. As such, it must conform to Tennessee State Board of Education (SBE) requirements as outlined in the Work-Based Learning Framework and the Tennessee Department of Education's Work-Based Learning Policy Guide.
Prerequisite(s):	Students should use their chosen elective focus and their high school plan of study as the basis for their Career Practicum experience. Students should participate in an aligned CTE program of study and/or other related courses prior to enrolling in this course. WBL experiences must reflect the student's long-term goals and interests and foster postsecondary and career preparation.
Grade Level:	11 or 12
Credit:	1 –2 credits per year, including the summer term
Elective Focus:	This course satisfies one of three credits required for an elective focus when placement aligns with the other elective courses as approved by the local board of education as per SBE High School Policy 2.103.
Integration with CTE Programs of Study:	This course may be taken as the third or fourth course in any sequenced CTE program of study. Placement should align with the other CTE courses taken.
Teacher Requirements:	Teachers must hold an active WBL certificate provided by the Tennessee Department of Education and one of the following endorsements: 007, 008, 021, 022, 023, 024, 025, 030, 031, 032, 033, 034, 035, 036, 037, 038, 039, 040, 041, 042, 043, 044, 045, 046, 047, 048, 049, 050, 051, 052, 053, 054, 055, 056, 057, 058, 059, 060, 061, 062, 070, 077, 078, 079, 080, 130, 131, 132, 133, 143, 144, 145, 146, 147, 150, 151, 152, 153, 154, 155, 156, 157, 158, 102, 103, 105, 201, 202, 203, 204, 230, 231, 232, 233, 250, 301, 310, 311, 407, 408, 421, 422, 423, 424, 425, 426, 430, 431, 432, 433, 434, 435, 436, 448, 449, 450, 451, 452, 453, 458, 460, 461, 462, 463, 464, 466, 470, 471, 472, 474, 475, 476, 477, 487, 496, 498, 503, 507, 508, 512, 522, 523, 524, 527, 531, 543, 560, 561, 562, 568, 576, 577, 581, 584, 590, 594, 595, 596, 597, 598, 700, 701, 702, 703, 705, 706, 707, 710, 711, 720, 721, 722, 730, 740, 742, 750, 751, 760, 770, 771, 772, 773, 774, 775, 776, 780, 781
Industry Engagement Requirements:	Significant industry engagement is required for this course and includes, but is not limited to, setting professional expectations for quality of work, mentoring students through a project and providing feedback, and evaluating employability

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	skill development. A dedicated workplace mentor will supervise each student in workplace-based experiences such as internships, co-op, and apprenticeships.
Teacher Resources:	http://tn.gov/education/topic/work-based-learning

Course Description

Work-Based Learning: Career Practicum is a capstone course intended to provide students with opportunities to apply the skills and knowledge learned in previous CTE and general education courses within a professional work environment. The course allows students to earn high school credit for select models of work-based learning, which allow students to interact with industry professionals in order to extend and deepen classroom work and support the development of postsecondary and career readiness knowledge and skills.

Career Practicum activities may take one of two forms:
1) **Workplace-Based**: Students participate in individual work-based learning experiences in professional settings when they meet the hours required for full time course equivalent. These experiences include registered apprenticeships, cooperative education (co-op), and internships.
2) **Classroom-Based**: Students are immersed in a classroom-based experience where they learn through targeted industry involvement that may take the form of industry-driven project-based learning, school-based enterprise, and virtual enterprise. This model should incorporate industry engagement through activities like tours, informational interviewing, job shadows, community service projects, and technical mentoring to achieve learning standards at professional-level expectations.

Upon completion of the practicum, students will be prepared for postsecondary and career opportunities aligned with their interests and demonstrate professional-quality employability skills relevant to their chosen career paths. ~~Standards in this course are designed to reinforce Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.~~*

Course Requirements

This capstone course aligns with the requirements of the Work-Based Learning Framework (established in Tennessee State Board High School Policy), with the Tennessee Department of Education's Work-Based Learning Policy Guide, and with state and federal Child Labor Law. As such, the following components are course requirements:
1) A student will have a Personalized Learning Plan that identifies their long-term goals, demonstrates how the Work-Based Learning (WBL) experience aligns with their elective focus and/or high school plan of study, addresses how the student plans to meet and demonstrate the course standards, and addresses employability skill attainment in the following areas:
   a. Application of academic and technical knowledge and skills (embedded in course standards)
   b. Career knowledge and navigation skills
   c. 21st Century learning and innovation skills
   d. Personal and social skills
2) A student will develop portfolios, or a similar compilation of work and evaluation samples, that demonstrate employability skill development in the categories above.
3) A student will exhibit work readiness attitudes and skills prior to beginning a WBL experience.

4) A student will have an up-to-date Training Agreement and Safety Training Log on site at the company and at the school as appropriate for workplace-based experiences. A copy of this required paperwork must be kept in school records for five years after placement.

5) An evaluation process must be used to ensure that experiences are high-quality for the student.

Work-Based Learning Framework

The Work-Based Learning Framework is established in SBE High School Policy 2.103 and governs all WBL experiences, both for-credit and not-for-credit. The Tennessee Department of Education's Work-Based Learning Policy Guide, *Personalized Learning Plan* template, and the Work-Based Learning Implementation Guide address training requirements, program expectations, and legal requirements. All documents are available online at: http://tn.gov/education/topic/work-based-learning. The standards for this course are written to conform with the SBE Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies.

Course Standards

These course standards are designed to cover the employability skills required by the Work-Based Learning Framework. As such, they are divided into three sections:

- Career knowledge and navigation skills
- 21st Century learning and innovation skills
- Personal and social skills

The application of academic and technical knowledge and skills are embedded throughout these standards to ensure compliance with SBE High School Policy 2.103.

Career Knowledge and Navigation Skills

1) ***Understand and demonstrate appropriate professional safety standards:*** Accurately read and interpret safety guidelines appropriate for the roles and responsibilities of the related placement or project. Listen to safety instructions and be able to explain why certain rules apply. Demonstrate good safety techniques and follow all applicable laws related to the project or placement and keep updated records of training topics in the Safety Training Log.

   Work-Place Example: Prior to an internship with a local manufacturer, a student receives training in the classroom related to electrical safety, Occupational Safety and Health Administration (OSHA), state and national code requirements, and the rules of handling high-pressure pneumatics and hydraulics. These trainings are documented in the student's Safety Training Log. Once on site, the student's workplace mentor provides additional training on the safety culture of the company and the specific equipment that the student will use, which has been pre-approved by the Department of Labor and Workforce Development. The student and employer update the student's Safety Training Log and an updated copy is placed in the student's personnel file at work and at the school.

2) ***Plan and navigate education and career paths aligned with personal goals:*** Observe and analyze organizational culture and practices, e.g., how to interact with supervisors, clients, and co-workers, and how to recognize and address health, safety, and sustainability issues. Seek information from supervisors and other employees about appropriate methods of finding and securing employment in the industry and what knowledge, skills, and educational credentials are required. Use the learning experience to review and update the student's long-term education

and career goals based on the knowledge and feedback acquired. Proactively identify areas of strength and opportunities for professional growth, encourage and act on feedback from peers, supervisors, and customers, and seek and use resources and support to improve skills.

Work-Place Example: During an experience at a local government agency, a student observes the roles of different professionals and asks supervisors and others about the educational credentials required for entry level positions in the fields the student found most interesting. The student follows up by talking with a school counselor about colleges and universities where those credentials could be earned, and what courses should be taken in high school to qualify for those credential programs. The student creates a resume and adds it to her portfolio to begin the application process for her selected postsecondary institution.

3) ***Develop and implement a personalized learning plan:*** Develop a Personalized Learning Plan specific to the student's placement or project, in accordance with approved policies. Participate in ongoing review and communications to determine progress against the plan with relevant stakeholders where necessary.
   a. Select and apply appropriate technical skills to accurately solve problems and perform expected tasks related to the work-based learning experience as outlined by the student's elective focus.
   b. Select and demonstrate appropriate format and style of communications in the work setting ~~as outlined by applicable Tennessee State Standards for English Language Arts & Literacy in Technical Subjects~~.
   c. Independently and proficiently read and comprehend academic and technical texts relevant to the work-based learning experience ~~as outlined by applicable Tennessee State Standards for English Language Arts & Literacy in Technical Subjects~~.
   d. Select and apply appropriate mathematical concepts to accurately solve problems and perform expected tasks related to work-based learning experiences ~~as outlined by applicable Tennessee State Standards for Mathematics~~.

4) ***Reflect on experiences through creation of a personal portfolio:*** Create a personal portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the Career Practicum course standards and the personalized learning plan. Identify and collect artifacts and/or work products that reflect the skills developed and knowledge gained through the WBL experience. Assess personal growth through thoughtful reflection and accurately self-assess to identify opportunities for further growth and development in the future. Products may include but are not limited to:
   - Career and professional development plan
   - Resume and/or references
   - Pictures, videos, or other media samples from the placement
   - Examples of materials developed and used throughout the placement
   - Journal entries reflective of tasks and activities
   - Supervisor evaluations and observations
   - WBL coordinator evaluations and observations
   - Exit evaluations that include lessons learned and self-analysis of skill development

21st Century Learning and Innovation Skills

5) ***Demonstrate creativity and innovation:*** Use idea-generating techniques to explore divergent and atypical questions and perspectives to develop original ideas for products or solve problems – such as a constructed object, proposal, presentation, solution to a problem, service, system, work of art, writing sample, invention, event, or an improvement to an existing product. Exhibit insight into the particular needs and interests of the target audience that are driving the process of innovation.

   Work-Place Example: A student brainstorms with co-workers to create game features for a new app and tests out the ideas on friends who fit the target audience profile. Using their feedback and open source repositories, the student learns how to make adjustments that differentiate the app and make it appealing to the target demographic.

6) ***Demonstrate critical thinking & problem solving:*** Identify and ask significant questions to solve problems in the workplace. Use inductive and deductive reasoning methods to recognize faulty reasoning and to understand problems and alternative solutions. Solve problems using systems thinking (e.g., by understanding problems in terms of complex processes and environments). Identify key information, components and relationships that enable, influence, and produce outcomes.

   Work-Place Example: A student reads a blueprint and helps prepare a project layout. By extracting information from the drawing, the student determines dimensions and calculates the quantity and cost of materials required. Using this information, the student drafts a project timeline to schedule orders and labor to ensure parts are delivered as needed during construction.

7) ***Communicate clearly and effectively, verbally and in writing:*** Articulate ideas effectively in written communications with supervisors, coworkers, and customers by developing and delivering messages in written deliverables. Verbally articulate ideas effectively in interpersonal communications with supervisors, coworkers, and customers by developing and delivering messages in oral presentations. Demonstrate effective listening skills, attending to the meaning and intention of communications, by accurately paraphrasing what has been heard and by communicating with individuals of diverse backgrounds, perspectives, and cultures.

   Work-Place Example: A student makes internal and external presentations on company products and services, confers with customers by telephone and in person, and accurately records details of inquiries, as well as actions taken.

8) ***Collaborate and work productively as a team member:*** Work effectively as a member of a team and address conflict with sensitivity and respect for diverse points of view. Demonstrate understanding of one's own impact and build on different perspectives to strengthen joint efforts. Demonstrate leadership where appropriate on collaborative workplace tasks. Effectively employ meeting management strategies, such as use of an agenda, time keeping and meeting facilitation strategies, identifying action items, and scheduling next steps.

   Work-Place Example: A student works with a diverse team in a warehouse to pull ordered items, package, and ship the items on time. The student alternates between taking the lead and assisting others as the situation demands.

9) ***Demonstrate information literacy:*** Access information efficiently using appropriate sources. Demonstrate understanding of the difference between credible and non-credible sources, including the difference between advertising and legitimate research. Evaluate information for usefulness, bias, and accuracy, and question information that may not be from credible sources. Demonstrate the ability to organize and manage information effectively and efficiently. Demonstrate ethical and legal uses of information, including adherence to all rules and regulations related to the sharing of protected information.

   Work-Place Example: A student follows written procedures for evaluating project proposals and applies provided criteria to determine eligibility.

10) ***Use technology effectively and appropriately:*** Use appropriate technology for information search and retrieval, synchronous and asynchronous communications, multimedia presentations, document production, quantitative and qualitative analysis, and information management. Use social networking and online collaboration tools such as shared documents and web conferencing to create, integrate, and manage information in group projects. Access and manage online communication and information using multiple digital devices such as laptop computers, tablets, smart phones, etc. Demonstrate adherence to all rules and regulations related to the use of electronic tools and the internet, including appropriate protection of passcodes and adherence to all security protocols.

    Work-Place Example: A student participates in project or staff meetings remotely using a web-based conferencing system, contributes to presentations using various applications, or enters data accurately into a database.

Personal and Social Skills

11) ***Demonstrate initiative and self-direction:*** Complete tasks as directed without direct supervision, knowing when questions or guidance should be requested. Exhibit resourcefulness and initiative in taking on new tasks and solving problems as appropriate to the workplace setting. Demonstrate interest in learning and exhibit personal agency in identifying and achieving instrumental and ultimate learning objectives. Demonstrate curiosity to learn more about the tasks, as exhibited in the workplace or industry. Explore deeper content on one's own and request opportunities for professional development. Demonstrate self-efficacy and confidence in one's ability to succeed in specific situations.

    Work-Place Example: A student identifies an opportunity to improve an existing marketing process using an online tool that automates and customizes messaging for its audience. Without being asked, the student researches the cost, use, and effectiveness of the tool, as well as potential drawbacks. The student then develops written documentation and presents the proposal to a supervisor for consideration and possible implementation.

12) ***Demonstrate professionalism and ethical behavior:*** Present oneself professionally and with proper etiquette, in accordance with norms of the industry and workplace. Demonstrate reliability and responsibility in attendance and in following through on agreed-upon tasks; communicate with supervisor when circumstances change. Demonstrate integrity and ethical behavior in all worksite activities including the use of tools and materials, handling of money, logging of hours, billing of clients, sharing of information, and completion of all personnel-related forms.

Understand and adhere to appropriate workplace non-discrimination standards on the basis of sex, race, color, age, national origin, religion, disability, marital status, sexual orientation, gender identity, pregnancy, veteran status, or any characteristic of a person or group unrelated to the workplace.

Work-Place Example: A student assists in preparing client files, and performs other delegated tasks under close supervision of an office employee, always maintaining a professional attitude and respecting client privacy and confidentiality.

13) ***Demonstrate interpersonal and social skills using cultural/global competence:*** Demonstrate effective and respectful interactions with coworkers, supervisors, and customers. Respect cultural differences at a worksite or project, and work effectively with people from diverse social and cultural backgrounds. Exhibit appropriate interpersonal behaviors regarding workplace hierarchy, use of time/punctuality, dress, food, holidays, and etiquette.

Work-Place Example: A student interacts effectively with a very diverse group of customers, supervisors, and other personnel, using learned customer service skills and a calm demeanor to exchange information and resolve problems.

14) ***Demonstrate adaptability and flexibility:*** Exhibit adaptability and flexibility in a variety of roles, jobs responsibilities, schedules and contexts. Work effectively when projects and tasks change or the priorities seem ambiguous. Demonstrate a willingness to alter behaviors or tasks as circumstances change. Respond positively to praise, setbacks, and constructive criticism.

Work-Place Example: A student follows instructions and responds well to constructive criticism and frequent changes in assignments while testing, repairing, and reassembling a wide array of mechanical parts for machinery and systems.

15) ***Demonstrate productivity and accountability:*** Manage time and projects effectively by setting goals; developing and using a system for prioritizing, planning and managing daily work; and seeking assistance and adjusting plans to adapt to changing circumstances. Demonstrate attention to detail, and degree of precision and accuracy appropriate to the task. Demonstrate accountability to coworkers and supervisors and customers by delivering work to agreed-upon standards and completing agreed-upon projects on time, and exhibiting pride in workmanship.

Work-Place Example: A student works independently, and as part of a team, to coordinate events and meetings. The student demonstrates the necessary punctuality, attention to detail, and accountability to other team members in completing assigned tasks and taking initiative to pitch in as required for scheduling, facilitating, and assisting all events and activities.

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: Students who are engaging in activities outlined above should be able to demonstrate fluency in all ten Reading standards at the conclusion of the course.

- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: Students who are engaging in activities outlined above should be able to demonstrate fluency in all ten Writing standards at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities. While not aligned to one specific conceptual category, students who are engaging in the activities outlined above should be able to demonstrate mathematical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- Employability Skills Framework, United States Department of Education. (2014). http://cte.ed.gov/employabilityskills

Service-Learning

Work-Based Learning Framework:	The Work-Based Learning Framework is outlined in SBE High School Policy 2.103 and governs all forms of work-based learning (WBL) experiences, including service-learning projects and courses.
Executive Director:	Chelsea Parker, (615) 741-2197, Chelsea.Parker@tn.gov
Course Code:	6104
Prerequisite(s):	None
Grade Level:	10-12
Credit:	1
Area of Elective Focus:	This course serves as a general elective credit and may count toward the student's required area of elective focus at the discretion of the LEA when it aligns with other electives taken.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course.
Teacher Requirements:	Teachers must attend and satisfy service-learning training requirements provided by the Tennessee Department of Education and hold any secondary endorsement to oversee this course for credit.
Teacher Resources:	https://tn.gov/education/article/service-learning

Course Description

Service-Learning is designed to place students in new situations where they apply their academic, technical, and social skills to serve others. Upon completion of this course, students will be able to structure an unstructured or ambiguous problem, connect personal development with academic attainment, and demonstrate citizenship and leadership skills. Students will also understand how their service-learning experiences fulfill an authentic need in the community and develop a portfolio of work that documents their discovery process and growth.

Approved January 29, 2016; Amended April 15, 2016

This process is facilitated through a dynamic teaching, learning, and reflection process known as IPARD. Students will **I**nvestigate a problem, **P**lan service, take **A**ction, **R**eflect throughout the experience, and **D**emonstrate what they have learned (**IPARD**). As a result of the IPARD process, students will apply their academic learning, build postsecondary and career readiness knowledge, and serve the community. Additionally, the course will incorporate the K-12 Standards of Quality Practice, written and adopted in 2008 by the National Youth Leadership Council (NYLC), to guide the service-learning experience. They include:

1. **Diversity**: Service-learning promotes understanding of diversity and mutual respect among all participants.
2. **Duration and Intensity**: Service-learning has sufficient duration and intensity to address community needs and meet specified outcomes.
3. **Link to Curriculum**: Service-learning is intentionally used as an instructional strategy to meet learning goals and/or content standards.
4. **Meaningful Service**: Service-learning actively engages participants in meaningful and personally relevant service activities.
5. **Partnerships**: Service-learning partnerships are collaborative, mutually beneficial, and address community needs.
6. **Progress Monitoring**: Service-learning engages participants in an ongoing process to assess the quality of implementation and progress toward meeting specified goals, and uses results for improvement and sustainability.
7. **Reflection**: Service-learning incorporates multiple challenging reflection activities that are ongoing and that prompt deep thinking and analysis about oneself and one's relationship to society.
8. **Youth Voice**: Service-learning provides youth with a strong voice in planning, implementing, and evaluating service-learning experiences with guidance from adults.

Work-Based Learning Framework
Service-learning is considered one of the many forms of work-based learning (WBL) in Tennessee. As such, service-learning experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103.

Course Requirements
1. Students will have a *Personalized Learning Plan* that identifies their interests and goals, ensures that the service-learning experience supports their academic learning, and

outlines how the student plans to meet and demonstrate the service-learning course standards. This learning plan will address how a student is developing the following:
   a. Career knowledge and navigation skills
   b. 21st Century learning and innovation skills
   c. Personal and social skills
   d. Application of academic knowledge and skills
2. Students will be engaged in each phase of the IPARD process to allow for a high quality service-learning experience.
3. The K-12 Standards of Quality Practice will be used to guide the service-learning experience.
4. Proficiency of standards will be evaluated and assessed throughout the IPARD service-learning process to ensure that experiences are high-quality and rigorous for each student.
5. Students will track learning throughout the service-learning project in a portfolio to demonstrate skill development aligned with their *Personalized Learning Plan* and proficiency in the service-learning course standards.

Course Standards

These course standards are designed to cover the knowledge and skills required by the state board's Work-Based Learning (WBL) Framework established in High School Policy 2.103. The application of academic knowledge and skills are embedded throughout these standards to ensure compliance with SBE High School Policy. This course is designed to reinforce Tennessee State Standards in literacy, using service-learning teaching methodologies.

As such, the course standards are divided into three sections:
   • Goals of Service-Learning and Theories of Leadership
   • Personal Safety and Demonstrating Quality Learning
   • Effective Program Management

Goals of Service-Learning and Theories of Leadership

1) ***Demonstrate initiative and self-direction:*** Identify and discuss issues that have an impact on you or on your community. Ask significant questions to identify opportunities to take personal leadership related to a chosen topic or project. Using the IPARD model, create a project plan to address a real, local community need and outline clear roles and responsibilities for all team members. Complete tasks as directed without direct supervision, knowing when questions or guidance should be requested. Further investigate tasks or topics of interest and explore deeper content

on one's own that may provide additional opportunities for learning. Display self-efficacy and confidence in one's ability to succeed in specific situations. Exhibit resourcefulness and initiative in taking on new tasks and solving problems as appropriate.

2) ***Demonstrate adaptability and flexibility:*** Exhibit adaptability and flexibility in a variety of roles, jobs responsibilities, schedules, and contexts to accomplish project goals. Assess the project and collaborate with outside sources as the project takes shape, adapting to needs that arise. Make adjustments to the project plan as necessary to make the best possible impact on the chosen issue or project. Demonstrate a willingness to alter behaviors or tasks and work effectively when projects and tasks change or the priorities seem ambiguous. Respond positively to praise, setbacks, and constructive criticism.

3) ***Demonstrate interpersonal and social skills using cultural/global competence:*** Investigate an organization or other outside source that has expertise related to the selected project for insight into the project or goals and how they impact the issue from their perspective. Interact respectfully and effectively with peers, teachers, and community organizations. Respect cultural differences in school and the community and understand their impact on the project or issue at hand. Investigate the impact the project may have more broadly as it relates to the community, state, or global issues. Work effectively with people from diverse social and cultural backgrounds to implement the project successfully. Exhibit appropriate interpersonal behaviors regarding hierarchy, use of time/punctuality, dress, food, holidays, and etiquette.

4) ***Demonstrate productivity and accountability:*** Manage time and projects effectively by setting goals; developing and using a system for prioritizing, planning, and managing daily work; and seeking assistance and adjusting plans to adapt to changing circumstances. Attend to details with a degree of precision and accuracy appropriate to the task. Collaborate with an outside organization or entity to ensure implementation of the project plan and progress toward the project goals. Demonstrate accountability to peers and individuals from partnering organizations by completing agreed-upon projects on time, delivering work to agreed-upon standards, and exhibiting pride in workmanship.

5) ***Understand and demonstrate appropriate leadership skills:*** Investigate various theories of leadership and discuss the environmental and personal traits that have

impacted successful leaders. Synthesize when various forms of leadership are appropriate and when they are not. Research a leader that has had an impact on the group's chosen issue and examine the factors that made them successful or not. Formulate a personal theory of leadership and communicate clearly how it applies to the project at hand. Identify ways to demonstrate personal leadership during the project and document them in the *Personalized Learning Plan*. Draw conclusions about where else these leadership skills may be used in life outside of school.

6) ***Collaborate and work productively as a team member:*** Work effectively as a member of a team and address conflict with sensitivity and respect for diverse points of view. Demonstrate understanding of individual impact and build on different perspectives to strengthen joint efforts. Effectively employ meeting management strategies such as using an agenda, time keeping, employing meeting facilitation strategies, identifying action items, and scheduling next steps.

Personal Safety and Demonstrating Quality Learning

7) ***Understand and demonstrate appropriate safety standards:*** Understand the physical and mental challenges of working on the chosen issue or project and identify safety issues relevant to the service-learning experience. Accurately read and interpret safety guidelines and applicable laws appropriate for the service-learning experience. Analyze and describe how safety issues impact the health and wellbeing of all parties involved. Demonstrate work behaviors consistent with safety standards throughout the experience. Reflect on the safety behaviors demonstrated by the group and draw conclusions about the quality of the safety compliance and what could be improved upon in the future.

8) ***Explore education and career paths aligned with personal goals:*** Observe and analyze the organizational culture and practices that impact the service-learning project, such as how to interact with supervisors, clients, co-workers, and classmates, and how to recognize and address health, safety, and sustainability issues. Identify credible sources and seek information about the professional standards for working in that environment and the skills needed to impact the success of the project or the organization's mission. Reflect on personal areas of strength and identify opportunities for growth, drawing conclusions about how this growth will apply to future experiences in life. Investigate the pros and cons of a career working with the chosen issue and write career goals based on what is learned.

9) ***Develop and implement a Personalized Learning Plan:*** Develop a *Personalized Learning Plan* specific to the service-learning experience that identifies personal goals for demonstrating growth in the following areas:
    a. The application of academic and technical knowledge and skills
    b. Career knowledge and navigation skills
    c. 21st Century learning and innovation skills
    d. Personal and social skills

    Using the personal theory of leadership developed in Standard 5, identify ways to demonstrate personal leadership during the project. To determine progress against the plan, participate in ongoing personal reflection and review of progress with relevant stakeholders (instructor, service-learning site leader, etc.), adjusting the plan as needed. Reflecting on career goals developed in Standard 8, draw conclusions about personal growth demonstrated throughout the service-learning project and how it will impact future career opportunities. Identify academic knowledge and skills from previous course work that were applied through the service-learning project and provide feedback and suggestions for improving the project that would better allow for skill development in all these areas.

10) ***Reflect on experiences through creation of a personal portfolio:*** Create a personal portfolio, or similar collection of work, that illustrates each phase of the service-learning experience. Collect artifacts and/or work products that reflect the skills developed and knowledge gained through the service-learning experience. Assess personal growth through varied reflection activities. Accurately self-assess to plan opportunities for further growth and development, drawing conclusions about how the project will continue to impact the community and the student, personally. Products may include but are not limited to:
    a. Project plan for the service-learning project, based on the IPARD model and developed by the student
    b. Examples (drafts as well as final products) of materials created and used for the service-learning experience
    c. Reflection products (examples - journal entries, brainstorming webs, quotes, songs, poems, drawings, photos, presentations, plays, impact statement, cartoons, service contracts, learning logs, storyboards, etc.)
    d. Pictures and/or video from the demonstration of service to a public audience
    e. Updated resume
    f. Personal theory of leadership

Effective Program Management

11) ***Demonstrate critical thinking and problem solving:*** Use brainstorming techniques to collect ideas or issues that impact the students or other people in the community. Identify a topic of real concern to the local community and determine the central reasons that it is of particular importance. Ask questions to inspect the various factors at play and identify organizations or people who are making a significant impact. Collect information from multiple sources and assess the relevance of each source in determining a potential solution. Use inductive and deductive reasoning methods to recognize faulty reasoning and to understand problems and alternative solutions. Identify key factors and relationships that address the root cause of the problem. Utilize collected information to develop and propose solutions. Create a chart or other visual display to communicate the challenge and proposed solutions to others.

12) ***Demonstrate creativity and innovation:*** Exhibit insight into the particular needs and interests of the target audience that are driving the selected project. Use idea-generating techniques to explore divergent and atypical questions and perspectives to develop original ideas to solve problems important to the local community. Research existing methods and resources that are available as well as local and global organizations seeking to make an impact on the selected topic. Propose new resources and methods that may never have been used to impact the selected topic in your community and assess the viability of each. Investigate creative ways to communicate the project effectively with internal and external stakeholders, create buy-in, and communicate successful outcomes after the project concludes.

13) ***Communicate clearly and effectively, verbally and in writing:*** Write a clear and concise vision and mission statement to summarize the primary intent of the group on the selected issue. Design goals for the project that will enable the team to have a successful impact. Write a project plan that effectively addresses how proposed actions address a real, local community need, and outline clear roles and responsibilities for all team members. Develop and deliver messages effectively in written products and oral presentations, presenting information, processes, and viewpoints in a clear, succinct, and accurate manner. Use context-specific vocabulary effectively in written personal communications with other teams, organizations and/or government agencies. Articulate ideas effectively in interpersonal communications with teachers, mentors, peers and community leaders. Demonstrate

effective listening skills and accurately paraphrasing what has been heard. Communicate effectively with individuals of diverse backgrounds, perspectives, and cultures.

14) ***Demonstrate information literacy:*** Access information efficiently using appropriate sources. Understand the difference between credible and non-credible sources, including the difference between advertising and legitimate research, when creating material (papers, proposals, etc.). Evaluate information for usefulness, bias, and accuracy and question information that may not be from credible sources. Organize and manage information effectively and efficiently and use a standard format of citation to reference sources. Follow all ethical and legal guidelines, including adherence to all rules and regulations related to sharing of protected information.

15) ***Use technology effectively and appropriately:*** Use appropriate technology for information search and retrieval, synchronous and asynchronous communications, multimedia presentations, document production, quantitative and qualitative analysis, and information management. Use social networking and online collaboration tools, such as shared documents and web conferencing, to create, integrate, and manage information in group projects. Access and manage online communication and information using a variety of digital devices such as laptop computers, tablets, smart phones, etc. Demonstrate adherence to all rules and regulations related to use of electronic tools and the internet, including appropriate protection of passcodes and adherence to all security protocols.

16) ***Demonstrate professionalism and ethical behavior:*** Throughout the IPARD process, present oneself professionally and with proper etiquette, in accordance with norms of the organization and activity. Demonstrate reliability and responsibility in attendance and in following through on agreed-upon tasks. Communicate clearly with organization or leaders when circumstances change. Behave with integrity and ethically in all activities including the use of tools and materials, handling of money, tracking of hours, sharing of information, and completion of all forms. Understand and adhere to appropriate non-discrimination standards on the basis of sex, race, color, age, national origin, religion, disability, marital status, sexual orientation, gender identity, pregnancy, veteran status, or any characteristic of a person or group unrelated to the workplace.

Standards Alignment Notes

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: Students who are engaging in activities outlined above should be able to also demonstrate fluency in all ten Reading standards at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: Students who are engaging in activities outlined above should be able to also demonstrate fluency in all ten Writing standards at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities. While not aligned to one specific conceptual category, students who are engaging in the activities outlined above should be able to demonstrate mathematical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- United States Department of Education [Employability Skills Framework](#)

Principles of Public Service

Primary Career Cluster:	Government and Public Administration
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6127
Prerequisite(s):	None
Credit:	1
Grade Level:	9-10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Government and Public Administration courses.
Programs of Study and Sequence:	This is the first course in the *Public Management and Administration* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit http://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	132, 423, 590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	http://tn.gov/education/article/cte-cluster-government-public-administration

Course Description

Principles of Public Service is a foundational course in the *Public Management and Administration* program of study. This course covers fundamental philosophies of constitutional government in the United States as well as basic principles of public management and administration, including history and development, organizational structures, and modern functions. Legal and ethical issues faced by public officials are also explored, as is technology's impact on public management. Upon completion of this

course, proficient students will explore career options in public management and administration and develop an understanding of the role and importance of civic engagement in democracy. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the foundational course in the *Public Management and Administration* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Government & Public Administration website at http://tn.gov/education/article/cte-cluster-government-public-administration.

Course Standards

Philosophy and Principles of Constitutional Government

1) Identify influential philosophers and other historical figures who shaped fundamental political theories and philosophies of government. Outline these foundational political ideologies and explain how they evolved to influence the development of the United States form of constitutional government. ~~(TN Reading 2; TN Writing 4)~~

2) Summarize the basic principles of the United States Constitution, citing and interpreting specific language in the text itself. Describe constitutional provisions for limiting the role of government, including the separation of powers among the legislative, executive, and judicial branches and the system of checks and balances. ~~(TN Reading 2, 4, 5, 6, 8; TN Writing 4, 9)~~

3) Explain the concept of federalism in American government. Drawing evidence from primary source documents, such as the Bill of Rights' Tenth Amendment, describe how the powers of American government are distributed across national, state, and local systems. Outline the different rights and responsibilities accorded to these layers of government in a model or graphic illustration. ~~(TN Reading 1, 2, 4, 5, 6; TN Writing 4, 9~~)

4) Gather and analyze information from technical texts or digital sources to compare and contrast the structure and functions of local, state, and federal governments. Generate a visual representation (chart, diagram, etc.) to illustrate important connections and distinctions in their organization and purpose. Interpret these structures and functions in the context of Tennessee by identifying how local and state governments interact in this state. ~~(TN Reading 2, 7, 8; TN Writing 4, 8)~~

History of Public Administration

5) Define public management and administration. Interpret and cite informational texts, such as scholarly journals and historical archives, examining the development and evolution of the public sector in general, and the management and administration of public services specifically. Write an informative essay that assesses the impact of major developments and advancements in public management and administration in the United States, including technology or practices that have improved the efficiency or effectiveness of services or programs. ~~(TN Reading 1, 4; TN Writing 2, 9)~~

6) Research and outline philosophies of government stewardship in public management and administration. Synthesize supporting evidence from multiple scholarly and professional sources to examine theories of government provision of services as an essential function of democracy. (TN Reading 2, 8; TN Writing 4, 7, 8)

Careers in Public Management and Administration

7) Use local news media and organizational websites to investigate occupations that make up the four career areas (public service, public administration, public management, and local governments) of the government and public administration sector. Demonstrate an understanding of each occupation by accurately articulating the following:
   a. Roles and responsibilities of the position
   b. Comparison of similar careers available in local, state, and federal government as well as non-profit agencies
   c. Educational, training, and certification requirements
   d. Location of occupations within the organizational hierarchy of the specific career area
   (TN Reading 2; TN Writing 4, 7, 8, 9)

8) Prepare a career profile for at least one occupation in each of the four career areas, using print, online, and/or personal interview sources to capture at minimum the following:
   a. Job description
   b. Essential knowledge and skills needed for the career
   c. Program or path of study to reach occupational goals, beginning with high school and proceeding through postsecondary
   d. Licensure and credentialing requirements
   e. Non-educational job requirements such as physical fitness tests, minimum age, and psychological evaluations.
   (TN Reading 2; TN Writing 4, 8, 9)

Government Provision and Administration of Services

9) Define and differentiate between public and private goods (e.g., national resources, national defense, and other public goods – vs. clothing, cars, and similar goods typically considered to be private in nature). Identify the characteristics that constitute a public vs. a private good (i.e., excludable, rivalrous, etc.), and investigate theories as to why the government or the private sector is better suited to provide each. Use supporting evidence to compose an argument for or against privatization of government goods or services with regard to efficiency, ethics, and economics. (TN Reading 1, 4, 9; TN Writing 1, 8)

10) Examine the roles, contributions, and involvement of government in public administration for the development and maintenance of public infrastructure (i.e., education, taxation, etc.). Compose a list of services typically provided by local, state, and federal governments. Identify the role of nonprofit organizations in providing services not available through government agencies. (TN Reading 1, 8; TN Writing 4, 7, 9)

11) Consult media commentary and academic journals on public management to produce a synthesis of current issues and trends surrounding government management of public affairs and interests. Compare the strengths and limitations of government powers such as taxation, defense, licensing, transportation, and related domains across different levels of government, and evaluate how contemporary trends affect the government's continued ability to steward the public good. (TN Reading 2, 8, 9; TN Writing 4, 7, 9)

Civic Engagement

12) Review a variety of resources including historical government and scholarly documents (i.e., United States Constitution, Federalist Papers, etc.) as well as modern digital resources (i.e., government websites, news media) to summarize in an informational essay one's personal and civic roles and responsibilities in a democratic society. (TN Reading 2; TN Writing 2, 4)

13) Compare and contrast the rights and duties of citizens at the local, state, and national levels by consulting specific government legislation and related texts. For example, examine compulsory education laws; requirements for military service; and constitutional guarantees such as freedom of expression and the right to vote. (TN Reading 2; TN Writing 2, 4)

14) Illustrate the scope of civic engagement by creating a visual representation that identifies and differentiates between conventional and progressive forms of civic participation (i.e., voting, campaigning, and similar conventional forms vs. progressive tactics like advocating for special interest groups and conducting public demonstrations). Determine the relationship between civic engagement and the evolution of democratic processes and policies in the United States For example, assess the impact of special interest groups on legislative priorities. (TN Reading 2, 4; TN Writing 6, 9)

15) Evaluate the role of citizens in a participatory democracy by analyzing opportunities for public policy development, organization, and implementation. Demonstrate an understanding of personal civic competency by creating a checklist of effective citizenship skills, knowledge, and attitudes. (TN Reading 2; TN Writing 9)

16) Identify methods for citizens to promote political awareness, advocacy, and involvement. Research important citizen movements (i.e., voting, labor, and civil rights), and compose an informative text describing their social and political effects. (TN Reading 2, 4; TN Writing 2, 6, 9)

Technology

17) Investigate how the evolution of technology has impacted local city services such as traffic monitoring, waste water treatment, and emergency management systems. Assess the extent of this impact on such parameters as cost efficiency, safety improvements, and response time to medical or crime-related emergencies. (TN Writing 7, 9)

18) Drawing evidence from current events and media/professional commentary, evaluate the security risks posed to individuals and society associated with the advancement of technology. Compare and contrast the benefits and dangers of increased access to public data, for example, or describe current government efforts underway to curb the threat of cyberterrorism. (TN Reading 1, 2, 7, 8; TN Writing 4, 8, 9)

Professionalism and Leadership

19) Explore the social, moral, and ethical issues encountered in public management and administration, such as public scrutiny, use of public funds, and information security. Discuss the legal and ethical standards of practice (confidentiality, privacy, disclosure) that public officials and employees must adhere to in compliance with local, state, and federal laws. (TN Reading 2, 4; TN Writing 4, 9)

20) Demonstrate the application of professional practices and skills specific to government and public administration workplaces. Describe the importance of planning and management skills and develop a summary of strategies for the development, prioritization, and management of goals and objectives. (TN Reading 2, 3; TN Writing 4)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Public Management and Administration

Primary Career Cluster:	Government and Public Administration
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6129
Prerequisite(s):	*Principles of Public Service* (6127)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Government and Public Administration courses.
Programs of Study and Sequence:	This is the second course in the *Public Management and Administration* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit http://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	132, 423, 590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	http://tn.gov/education/article/cte-cluster-government-public-administration

Course Description

Public Management and Administration is the second course in the *Public Management and Administration* program of study. This course covers basic organization and management principles of public and nonprofit organizations, including standard policies and procedures, emerging trends, community planning, and funding and budgeting. Throughout the course, students will continue to explore career options in public management and administration, while gaining a deeper understanding

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of the government roles and responsibilities to its citizens. Upon completion of this course, proficient students will be able to articulate roles and responsibilities of individuals involved in government operations. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the second course in the *Public Management and Administration* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Government & Public Administration website at http://tn.gov/education/article/cte-cluster-government-public-administration.

Course Standards

Careers in Public Management and Administration

1) Explore and compare local and regional career opportunities in public management and administration. Drawing evidence from multiple sources, such as the U.S. Bureau of Labor Statistics, evaluate labor data to describe the projected need for one or more careers in a public management or administration-related field. Detail in a written or visual representation the knowledge, skills, and abilities necessary for a diverse range of careers in public management and administration. ~~(TN Reading 1; TN Writing 4, 8, 9)~~

2) Gather and compare information from a variety of authoritative sources to synthesize a list of common government and non-profit organization ethics and policies. In an informative narrative, explore the philosophical, social, and moral issues associated with the establishment of ethical standards of practice and legal policies specific to employment within public service, government agencies, and non-profit organizations. ~~(TN Reading 2, 5, 6; TN Writing 2, 4, 8, 9)~~

3) Assess the importance of interpersonal skills for successful professional relationships in public management and administration. Create a checklist of effective oral and written communication skills needed for professional competency in government and public service-oriented careers. ~~(TN Reading 2, 6; TN Writing 4, 9)~~

Organization and Management

4) Research historical and current trends in government organization and management. Summarize recent changes in government structure and policies, and compose an informative essay citing evidence to support an analysis of the positive and negative effects of these changes. Include an exploration of any unintended consequences of the changes. ~~(TN Reading 1, 2, 8; TN Writing 2, 4, 7, 9)~~

5) Consult informational texts, such as *The CIA World Fact Book*, to assess the implications of a variety of geopolitical conditions on government organization, management, and administration, including geographical location, economic significance of specific regions (natural resources, industries, etc.), and population demographics. ~~(TN Reading 2, 5, 7; TN Writing 4, 9)~~

6) Identify the roles and contributions of government in meeting the needs of a diverse society. Using both print and electronic resources, examine scholarly analyses (such as public policy review journals and case studies) and popular media to evaluate the positive and negative effects of government policies on certain populations based on their geographic location, culture, or religious affiliation. For example, evaluate how interpretation of the Free Exercise Clause of the First Amendment affects religious expression. (TN Reading 2, 7, 9; TN Writing 2, 4, 8, 9)

Nonprofit Organizations

7) Define nonprofit organization and use a variety of resources, such as the *IRS Guide to Tax Information for Charities and Other Non-Profits*, to compose a checklist of fundamental requirements for legal classification of non-profit status. (TN Reading 2, 4; TN CSS Writing 4)

8) Research the evolution of nonprofit organizations in the United States, examining theories related to the nonprofit sector's role in the provision of public services. Select three nonprofit organizations (local, state, national, or international), examine their mission statements, and discuss how their services seek to fill specific societal or economic needs. (TN Reading 1, 2, 6, 8; TN Writing 4, 7, 9)

9) Compare and contrast common roles and services of nonprofit organizations and government agencies. Identify social, political, and economic trends that affect nonprofit organization objectives and functions. (TN Reading 2, 5; TN Writing 4)

10) Summarize the organizational elements and policies specific to nonprofit entities, including tax exemptions and incentives, transparency and accountability, and risk management. (TN Reading 2, 4; TN Writing 4, 9)

Procedures, Policies, and Trends

11) With the aid of public documents, textbooks, or government websites, create a chart that compares the legislative and electoral processes of city, county, and state governments. Identify the roles of public agencies in supporting elected officials to meet goals and objectives, and in endorsing approved legislation. (TN Reading 2, 7, 9; TN Writing 4, 8, 9)

12) Discuss the importance of strategic planning for government and public agencies. Summarize procedural and organizational policies specific to government and public agencies, including fiscal regulation, accountability, risk management, and personnel management. (TN Reading 2, 4; TN Writing 4, 9)

13) Compare two simple (25 or fewer pages) strategic plans (or executive summaries of strategic plans) from local government agencies or non-profit organizations (for example, the *Downtown Memphis Strategic Plan* and the *Tennessee Technology Center at Memphis Strategic Plan*) and identify the common elements (such as mission statement, goals, objectives, strategies, performance measures, timeline) found in each. Use the identified elements as a template to create a strategic plan for a school organization. (TN Reading 1, 5, 9; TN Writing 2, 4, 7, 9)

14) Identify social, political, and economic trends that affect government and public agency organization objectives and functions. Research and generate connections between media

exposure of political issues or events and the subsequent impact on individuals, political parties, interest groups, and government officials and employees. (TN Reading 1, 5, 6, 8; TN Writing 4, 7, 9)

Fiscal Management

15) Using print and digital media coverage of current events, summarize contemporary legal, ethical, and technological issues in the fiscal management of public and nonprofit agencies and government entities. (TN Reading 2, 9; TN Writing 4)

16) Investigate resources for the funding of public and nonprofit agencies and government entities and compose a list of common government and private financial sources (such as foundations, institutions, and public grant-making entities). (TN Reading 2; TN Writing 4, 7, 9)

17) Analyze strategies and systems used to monitor and control financial resources. Compare and contrast accounting procedures and budgeting systems used in public and non-profit agencies and government entities. Examine regulations associated with accounting procedures and identify established standards and requirements. (TN Reading 1, 3, 5, 7; TN Writing 4, 9)

18) Identify procurement procedures common to public and nonprofit agencies and government entities, including public disclosure of required information, preparation and dissemination of documentation as required by law or policy, and contract creation, monitoring, and fulfillment. (TN Reading 2, 4, 9)

Community Planning

19) Define community planning and conduct a short research project on its historical development in the United States. Using community planning case studies publicly available from government agency websites such as fhwa.dot.gov, fema.gov, faa.gov, and epa.gov, examine the modern roles of public agencies in planning for transportation, emergency services, and public protection. (TN Reading 1, 8; TN Writing 4, 7, 9)

20) Drawing on examples (found in plans or minutes of meetings) retrieved from public agency websites, nonprofit documents, or campaign literature related to community initiatives, summarize the elements commonly found in a comprehensive community plan. Create an outline that illustrates the basic steps of the community planning process. (TN Reading 2, 7; TN Writing 4, 7, 9)

21) Compare and contrast types of data (demographics, tax base, etc.) used in community planning. Develop guidelines for accurate data collection and objective data interpretation for the evaluation and response to current and future public needs of a target community. (TN Reading 2, 4, 5; TN Writing 4, 7, 9)

22) Identify common barriers in community planning processes including environmental, legal, political, and fiscal issues. Research a selected target community to identify specific community planning barriers and compose an action plan (including goals, action steps, and methods of evaluation) for addressing those barriers, justifying selected actions with claim(s) and

counterclaim(s) and sound reasoning. Review action plan with peers and strengthen plan with revisions based on feedback. (TN Reading 2, 8; TN Writing 1, 4, 5, 6, 7)

23) Investigate the application of specialized technologies in public planning in the local area. Examples might include the use of geographic information systems (GIS) by appraisal districts, smart meters used by public utilities, automated emergency announcements, and streamed video of live meetings. (TN Reading 2, 4; TN Writing 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Public Law and Budgeting

Primary Career Cluster:	Government and Public Administration
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6128
Prerequisite(s):	*Public Management and Administration* (6129)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Government and Public Administration courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Public Management and Administration* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit http://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	132, 423, 590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	http://tn.gov/education/article/cte-cluster-government-public-administration

Course Description

Public Law and Budgeting is the capstone course in the *Public Management and Administration* program of study. This course covers advanced topics such as laws and regulations affecting business operations of government, government funding sources, and budgeting practices, in addition to providing students with the opportunity to develop an original proposal for a community initiative that will involve ongoing engagement with local citizens and officials. Upon completion of this course, proficient students will

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utilize knowledge and skills developed through the *Public Management and Administration* program of study to develop a capstone project addressing an issue of local importance. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the capstone course in the *Public Management and Administration* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Government & Public Administration website at http://tn.gov/education/article/cte-cluster-government-public-administration.

Course Standards

Laws and Regulations

1) Compare and contrast government operation regulations mandated by local, state, and federal laws. Identify laws that govern the business activities and operations of cities, municipalities, towns and counties. Create a graphic organizer or other visual representation of laws that regulate government business operations and transactions including: business contracts, budgeting, labor practices, domestic and global commerce, taxation, etc. ~~(TN Reading 2, 9; TN Writing 4, 6)~~

2) Identify laws that govern information management and privacy in relation to public management and administration settings. Summarize critical components of legal regulations pertaining to information security, acceptable use policies, technology use policies, and open and closed meetings. ~~(TN Reading 2; TN Writing 4, 8)~~

3) Describe the applications and objectives of city, county, and state charters, bylaws, codes, and ordinances. Analyze and report to the class (for example, in a presentation) on the legal processes and systems used to govern city, county, and state governments. Research and describe procedures for documenting and reporting violations in compliance with legal regulations, citing specific textual evidence. ~~(TN Reading 1, 2; TN Writing 4, 8, 9)~~

Funding

4) Differentiate among various local government funding sources by defining and describing how taxes, fees, grants, and bonds are used to fund local government. For example, discuss how local property taxes fund American public school systems, comparing and contrasting the funding streams of specific localities. Research and develop an informational resource for government and nonprofit agencies to assist in the exploration and procurement of operational funds using various funding sources. ~~(TN Reading 1, 9; TN Writing 4, 7, 8, 9)~~

5) Examine a local government's tax base and structure. Describe the implementation of and revenue stream provided by specific taxes (i.e., property taxes, sales taxes, vehicle taxes). Create a flow chart that illustrates the process of local taxation from implementation of tax, collection of monies, to allocation of funds for specific government services or activities. ~~(TN Reading 2; TN Writing 4, 8, 9)~~

6) Describe the implementation and revenue stream provided by fees levied by the local government (i.e., permit fees, liquor fees, licensure fees, motor vehicle fees, etc.). Describe how factors such as geographic location and demographics can affect the application of certain fees and their effectiveness for generating revenue. (TN Reading 1, 9; TN Writing 4, 9)

7) Identify financial service providers, such as those who provide business credit and financing to government entities, and describe common credit and financing terms provided for local government operations. Physically or virtually visit a variety of financial service providers to collect informational literature on credit and financing services. Compose a summary of funding options available to organizations in the local area. (TN Reading 2, 9; TN Writing 2, 4)

Accounting and Budgeting Practices

8) Define generally accepted accounting principles (GAAP) and describe the general application of accounting processes and systems for planning, monitoring, and controlling financial activities. Conduct research by examining the *Federal Accounting Advisory Board (FASAB) Handbook* and other authoritative sources to identify accounting system standards specific to public agencies regarding the production, retention, and disposal of financial records and statements. (TN Reading 2, 4, 8, 9; TN Writing 7, 8, 9)

9) Cite specific examples provided by the American Institute of Certified Public Accountants (AICPA) to summarize accounting control procedures such as expense control, tracking, billing, expenses, payroll, auditing, record-keeping, purchase requisitions, and inventory control. Conduct a survey of local government and nonprofit entities to examine the use of accounting software or other technologies to improve accuracy and efficiency of accounting systems. (TN Reading 1, 4, 9; TN Writing 4, 7, 9)

10) Differentiate among different types of budgets (i.e., revenue, expenditure, etc.) and explain when they are used. Research and describe basic budget elements, common budget issues and resolutions. Using authentic resources (such as local government offices and independent accounting firms), compose a checklist of suggested tools and techniques for efficient and effective budget creation. (TN Reading 5, 7, 8, 9; TN Writing 4, 8, 9)

11) Research budget processes for local, county, and state governments. Identify accounting practices and government policies that affect the development and implementation of government budgets, including community needs, public disclosure, fiscal opportunities and challenges, program operation, and capital policies and procedures. (TN Reading 2, 4, 9; TN Writing 4, 8, 9)

12) Identify the knowledge and skills needed to prepare, adopt, and administer a budget. Discuss the importance of ongoing budget evaluation and adjustment. Using case studies or current media sources, examine government-specific situations in which systems for monitoring and evaluating budgets failed and articulate implications of failures. (TN Reading 2, 7, 9; TN Writing 4, 9)

Professionalism and Leadership

13) Explore leadership skills needed in public management and administration, such as collaboration and negotiation. Synthesize strategies to initiate and maintain collaborative relationships and, using case studies, explore examples of when a lack of collaboration and/or negotiation led to challenges. Throughout the course, demonstrate appropriate standards of conduct for the organization, participation, and supervision of meetings, both in class and at appropriate community events. (TN Reading 2, 9; TN Writing 4, 9)

14) Demonstrate the application of professional communication skills in the context of government and public administration workplaces, including internal and external business correspondence, public speaking, and the crafting and delivering of multimedia presentations. (TN Reading 2, 3; TN Writing 6, 9)

Community Planning Capstone Project

15) Analyze current digital and print media to identify authentic public issues such as transportation, health, safety, recreation, or environmental issues prevalent in the local community or region. Craft an argumentative essay, using data-driven evidence, making a claim about the appropriateness and effectiveness of local government engagement with selected community issues. (TN Reading 2, 7; TN Writing 1, 4, 8, 9)

16) Distinguish between community issues to select a specific need that could be effectively addressed through public policy and the actions of local government. Compose an informational essay or needs assessment that thoroughly and accurately defines the selected issue (i.e., what, who, where, when, why), and summarize the current impact on the community. (TN Reading 2, 7, 9; TN Writing 2, 4, 9)

17) Based on previous community planning research, identify agencies currently addressing the selected issue, or who would be appropriate to address. Review appropriate methods of business communication and correspondence and determine specific representatives or entities to contact for possible collaborative relationships, including local officials, media, and organizations (government, public agency, private, nonprofit, and/or special interest groups, etc.). (TN Reading 2, 8, 9; TN Writing 4, 9)

18) Gather and synthesize research such as feasibility studies, community surveys, and needs assessments from a variety of sources (i.e., interviews, written correspondence, print and digital media, websites, articles, reports, plans, government and nonprofit organization offices, etc.). Evaluate the appropriateness and validity of information resources and collected data. Review case studies or other current media sources to explore the use of appropriate technologies. Document findings in an organizer to assist in the capstone project. (TN Reading 2, 5, 6, 7, 8, 9; TN Writing 7, 9)

19) Integrate collected data and research to compose a proposed policy or Plan of Action consisting of multiple solutions to address the selected issue. Construct a well-reasoned analysis and describe specific actions that could be performed by citizens and the community at large in addition to proposed formal policy development. Project the likely impacts and effectiveness of suggested solutions. (TN Reading 9; TNWriting 1, 4, 5, 6, 8, 9)

20) Expand upon current understanding of accounting and budget procedures to create a budget that identifies funding sources and the appropriate allocation of funds for the proposed policy or plan of action. (TN Reading 2, 3, 7; TN Writing 4, 8)

21) Employ knowledge of laws affecting government operations to evaluate any legal ramifications surrounding the proposed policy or plan of action, including conflicts with existing legislation, observance of city, county, or state guidelines, bylaws, and ordinances, and adherence to health, environment, and security guidelines and regulations. (TN Reading 2, 7; TN Writing 4, 9)

22) Create a technology-enhanced multimedia presentation showcasing the proposed policy or plan of action. Request the opportunity to present it to a variety of community audiences (peers, school board, local officials, government council or committee meetings, community stakeholders, etc.). (TN Reading 2, 7, 9; TN Writing 6, 9)

23) Upon conclusion of the capstone project, compose a formal informational essay reflecting on project highlights, challenges, and lessons learned from the experience. (TN Writing 2, 4, 7, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Health Science Education

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5998
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the first course in all programs of study in the Health Science career cluster.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Health Science Education is an introductory course designed to prepare students to pursue careers in the fields of biotechnology research, therapeutics, health informatics, diagnostics, and support services. Upon completion of this course, a proficient student will be able to identify careers in these fields, compare and contrast the features of healthcare systems, explain the legal and ethical ramifications of the healthcare setting, and begin to perform foundational healthcare skills. This course will serve as a

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strong foundation for all of the Health Science programs of study. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the foundational course in all programs of study in the Health Science career cluster. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Career Planning

1) Synthesize information found in news media, professional journals, and trade magazines to create a report and/or presentation on the historical evolution of healthcare in the United States. Use a timeline or other graphic to illustrate major developments beginning with the first medical school through today. ~~(TN Reading 2, 7; TN Writing 6, 8)~~

2) Prepare a paper or electronic career profile for at least one occupation in each of the five health science career areas (biotechnology research, therapeutic services, support services, health informatics, and diagnostic services), to be included in the student's health science portfolio. Draw on print and online sources, such as government occupational profiles, and/or interviews with health care professionals to capture at minimum the following:
   a. Job description
   b. Roles and responsibilities
   c. Essential knowledge and skills needed for the career
   d. Programs or paths of study available to reach occupational goals, beginning with high school and proceeding through postsecondary
   e. Required personality traits for the career
   f. Licensure and credentialing requirements
   g. Non-educational job requirements such as physical fitness tests, minimum age, and psychological evaluations
   h. Photographs or digital prints of each career (refer to HOSA Medical Photography guidelines)
   ~~(TN Reading 1, 2; TN Writing 4, 6, 9)~~

3) Drawing evidence from occupational profiles, industry journals, and textbooks, summarize the professional traits (such as leadership, ethical responsibility, and time management) required of healthcare professionals in the twenty-first century. ~~(TN Reading 1; TN Writing 9)~~

Healthcare Systems

4) Identify the types and defining features of healthcare systems in the United States. Compare and contrast these systems with those of other countries that have a high efficiency score in healthcare as rated by agencies such as the World Health Organization. Create a report and/or presentation on these comparisons. ~~(TN Reading 1, 5; TN Writing 7, 8 ,9)~~

5) Compare and contrast the average cost for a procedure such as childbirth, CT scan, and/or heart catheterization in the United States versus the average costs in Canada, Mexico, France, Japan, and/or other countries that have high efficiency scores in healthcare. Translate the information into a table, chart, graph, or other visual representation. Cite specific textual evidence to support the analysis. (TN Reading 1,5; TN Writing 7)

6) Differentiate among the methods of payment for healthcare in the United States. Include private and state or federal insurance, health savings accounts, managed care, Veteran's Health Administration, Military Health System/TRICARE, and long-term care. (TN Reading 1, 9)

7) Investigate current innovations in healthcare. Develop pro and con arguments based on information found in news media, professional journals, and trade magazines on how innovations have influenced the healthcare system. Support arguments with evidence presented in oral, visual, or written format. (TN Reading 1, 2, 9; TN Writing 1, 8, 9)

Body Function and Structure

8) Outline basic concepts of normal structure and function of all body systems, and explain how homeostasis is maintained. (TN Reading 2)

9) Describe how Maslow's Hierarchy of Needs can affect the physical, social, psychological, and behavioral status of a person. Use technology to produce a visual or digital chart or table to explain the information obtained from published or digital text. (TN Reading 1; TN Writing 6, 9)

10) Generate an informational brochure that explains to community members the biophysical, mental/cognitive, social, and emotional development of patients at various stages of the life cycle: infancy, toddler, school age, adolescence, and adulthood (young, middle, and older). Cite textual evidence to support explanations. (TN Reading 1; TN Writing 9)

11) Distinguish between the medical definitions of health and wellness, identifying preventive measures and behaviors that promote each. Discuss contemporary controversies to wellness theories, such as but not limited to the debates surrounding electronic medical records, the use of performance-enhancing supplements for athletes, and alternative diets. (TN Reading 5)

12) Develop a patient health education presentation surrounding one of the following wellness issues: optimal health, exercise and fitness, healthy eating and nutrition, sleep, stress or other mental health issues, drug/alcohol/tobacco use and abuse, body decoration, sexually transmitted infections, or cyber safety. Include signs and symptoms of the behavior and/or disease, major physical concerns associated with it, preventive measures, treatments, and support systems. Include at least three resources. (TN Reading 1, 3, 5; TN Writing 2, 4, 7, 9)

Infection Control/Medical Microbiology

13) Define chain of infection and provide strategies of how to break each part of the chain to prevent infection. Conduct a short research project on the effects of practices of sanitation and disinfection on health and wellness, examining the implications for public health. Synthesize findings in a written, oral, or digital presentation, citing evidence from the investigation. (TN Reading 1; TN Writing 6,7)

14) Understand the principles of and successfully perform the following skills to prevent or curtail the spread of pathogenic and non-pathogenic organisms:
   a. Hand washing
   b. Gloving
   (TN Reading 3)

Foundational Healthcare Skills

15) Review health topics surrounding complementary and alternative medicine such as acupuncture, biofeedback, and herbal treatments. Develop a public service announcement or academic poster presentation intended to inform consumers or health professionals about the specific topic. Include general information, purported benefits, uses in the United States, side effects and/or risks, relevant research, cost, and links to more information. Cite evidence from print and digital resources such as research journals, the National Institute of Health, the Mayo Clinic, and Medline Plus. (TN Reading 1, 9; TN Writing 2, 6, 8, 9)

16) Understand principles of and successfully perform skills related to Emergency Medicine, incorporating rubrics from the American Heart Association or American Red Cross for the following:
   a. Basic First Aid care of bleeding and wounds
   b. Basic First Aid care for burns
   c. Basic First aid for bone and joint injuries
   (TN Reading 3)

17) Understand principles of and successfully perform skills related to Dental Assisting, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Identifying teeth using the Federation Dentaire International Numbering System
   b. Demonstrate brushing and flossing techniques
   (TN Reading 3)

18) Understand principles of and successfully perform skills related to Medical Laboratory Assisting, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Obtain a culture specimen and streak an agar plate (this may be simulated on paper)
   (TN Reading 3)

19) Understand principles of and successfully perform skills related to Medical Assisting Skills, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Temperature, pulse, respiration and blood pressure assessment
   b. Screening for vision problems
   (TN Reading 3)

20) Understand principles of and successfully perform skills related to Physical Therapy Skills, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Ambulation with crutches or cane
   b. Administering cold applications
   (TN Reading 3)

21) Understand principles of and successfully perform skills related to Athletic Training, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Assessment of athlete with injured ankle or wrist
   b. Basic stretching exercises
   (TN Reading 3)

22) Understand principles of and successfully perform skills related to Forensic Scientist, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Extraction of basic DNA
   (TN Reading 3)

The following artifacts will reside in the student's portfolio:
- Career Exploration portfolio
- Skills performance rubrics
- Documentation of job shadowing hours
- Examples of written, oral, or digital presentations
- Short research project documents
- Examples of public service announcement scripts, community awareness, health education portfolio

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5 and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Notes

**Informational artifacts include but are not limited to brochures, posters, fact sheets, narratives, essays, and presentations. Graphic illustrations include but are not limited to charts, rubrics, drawings, and mode

Diagnostic Medicine

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5994
Prerequisite(s):	*Health Science Education* (5998)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the second course in the *Biotechnology Research* and *Diagnostic Services* programs of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Diagnostic Medicine is a second level course designed to prepare students to pursue careers in the fields of radiology, medical laboratory, optometry, and other patient diagnostic procedures. Upon completion of this course, proficient students will be able to describe new and evolving diagnostic technologies, compare and contrast the features of healthcare systems, explain the legal and ethical ramifications of the healthcare setting, and begin to perform foundational healthcare skills. In addition, students will continue to add artifacts to a portfolio, which they will continue to build throughout the program of study. Standards in this course are aligned with Tennessee State Standards in English Language Arts &

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Program of Study Application

This is the second course in the *Biotechnology Research* and *Diagnostic Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Career Planning and Professionalism

1) Revise the career information portfolio developed in the *Health Science Education* course and update with more in-depth information surrounding careers in diagnostic sciences. Identify specific roles and responsibilities for each career in this field. Investigate and compare the range of skills, competencies, and professional traits required for such careers. Compare findings to current individual strengths and identify opportunities for personal development. (TN Reading 1, 2; TN Writing 2, 9)

2) Summarize the Health Insurance Portability and Accountability Act (HIPAA), in particular those aspects related to maintaining confidentiality, patient rights, patient safety, and other ethical/legal directives governing medical treatment. Using medical terminology and accurate definitions of legal concepts, explain how the content of these ethical/legal ramifications affects patients' rights for all aspects of care. (TN Reading 1, 2, 4, 5; TN Writing 2)

Technology

3) Differentiate between telemedicine and telehealth. Identify the areas in which telehealth and/or telemedicine are being utilized nationally and globally with success. Describe in a written, verbal, or digital format what barriers currently exist to implementing such technologies on a larger scale, and outline any initiatives that can be incorporated to reduce the barriers. (TN Reading 2, 4, 9; TN Writing 2, 6, 8)

4) Investigate and document the history of radiology, medical laboratories, and other related areas of diagnostic medicine. Explain how technology is influencing the future of each. Synthesize research from professional journals and other medical or technical literature (noting the authors and their purposes) to analyze the barriers to these technologies and predict how the industry might respond. (TN Reading 1, 2, 6, 8, 9; TN Writing 7, 8, 9)

5) Synthesize information from professional journals and digital resources to investigate the use of robotics in healthcare other than in surgical procedures. Develop a proposal, sketch, mock press release, or similar written artifact for a new technology or an improvement to a current technology that can be used in the field of diagnostics. Detail all the specifications of the new technology, including an explanation of how the technology will be used, the projected cost-saving measures, and the most applicable professions that would use the technology. (TN Reading 1, 2, 4, 7, 9; TN Writing 2, 4, 8, 9)

6) Evaluate data from research articles encompassing the reliability of home testing kits (i.e., pregnancy test) and portable diagnostic equipment (i.e., glucometers). Explain findings in an informational essay, citing at least three different peer-reviewed articles and including appropriate medical terminology. (TN Reading 1, 2, 4, 8; TN Writing 2, 7, 9)

Safety

7) Obtain medical laboratory manuals from at least three different resources or physical laboratory sites. Identify the elements of containment regarding general infection control, chemistry precautions, fire safety, chemical hazards, electrical safety, mechanical safety, general lab safety, accident exposure, and disaster preparedness. Develop a written or digital lab manual for a medical laboratory at school based on findings from the research. (TN Reading 2, 4, 5, 9; TN Writing 4, 6, 8, 9)

8) Research the guidelines pertaining to radiation safety for staff, patients, and family who are receiving any radiological procedure. Develop an informational artifact, public service announcement, or health education presentation that instructs patients/clients on what patients should know about medical radiation safety. (TN Reading 3, 4, 9; TN Writing 2, 6, 9)

9) Explore policies and procedures related to diagnostic equipment quality control monitoring and evaluation. Synthesize information into a digital or written presentation to instruct appropriate staff on the importance of implementing quality control processes according to policy. (TN Reading 3, 4, 9; TN Writing 2, 6, 8, 9)

Infection Control/Medical Microbiology

10) Demonstrate mastery of concepts and skills related to asepsis, Universal Precautions, sanitation, disinfection, and sterilization for patient/client care settings in adherence to standards and guidelines from the Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA) in a lab/clinical setting. (TN Reading 3)

11) Define the term normal flora and explain how its deviation can prevent or cause a disease or disorder. Outline specific preventive measures to align to acceptable standards of care in the healthcare field. (TN Reading 4; TN Writing 4; TN A&P 5)

12) Assess the differences between healthcare-associated infections and non-healthcare-associated infections using examples drawn from mock patient documents or case studies. Support explanations with relevant surveillance statistics, preventive measures, and methodologies concerning outbreak detection, management, and education. (TN Reading 1, 3, 4; TN Writing 4, 7, 9)

Diagnostic Radiology

13) Outline the in-depth normal structure and function of the musculoskeletal, nervous, and respiratory systems, specifically as they relate to radiology. Review directions, planes, and sections of the body in order to perform radiographic images. Summarize appropriate medical text(s) in order to list signs and symptoms of common diseases and disorders associated with each. (TN Reading 1, 2, 3, 4, 9; TN Writing 9; TN A&P 2, 3)

14) Distinguish between the various types of diagnostic radiology, citing the uses, advantages, and disadvantages of each. Develop an explanation that would be used for beginning health science students, incorporating appropriate industry and medical terminology. (TN Reading 2, 4, 9; TN Writing 2, 4)

15) Research the principles of radiographic physics and explain how the concepts are applied to produce high-quality radiographic images. Discuss the following in the explanation:
    a. Electromagnetic spectrum and ionizing radiation
    b. Properties of X-rays
    c. Production of X-rays
    d. The X-ray tube and other parts of an X-ray machine
    e. Factors affecting the quality and intensity of beam
    f. Interaction of X-rays with matter
    (TN Reading 2, 4, 9; TN Writing 2, 8, 9; TN Physics 5)

16) Identify the equipment used in radiographic imaging. Describe in a written, oral, or digital format the following:
    a. Properties of a radiographic film and the process related to the formation of a radiographic image
    b. Effects of exposure factors on the film
    c. Uses of cassettes and intensity screens
    d. Implications of these and other considerations on the quality of a diagnostic radiograph
    (TN Reading 4, 5; TN Writing 2; TN Physics 5, 6)

17) Understand principles of and successfully perform interpretation skills for radiographic images, incorporating rubrics from textbooks or clinical standards of practice. Identify any anatomical abnormalities and document findings per industry standards related to terminology and format. (TN Reading 3, 4; TN Writing 7; TN A&P 2)

Clinical Laboratory

18) Outline the in-depth normal structure and function of blood and related components. Summarize appropriate medical text(s) in order to list signs and symptoms of common blood diseases and disorders associated with each. Define the following common laboratory procedures, both normal and abnormal, and provide the reasoning for why the test should be obtained:
    a. Complete Blood Count
    b. Complete Metabolic Panel
    c. Fasting Lipid Panel
    d. Hgb A1C
    (TN Reading 3, 4, 9; TN Writing 8, 9; TN A&P 4)

19) Develop a graphic organizer or concept map to explain the functions of the various departments of a medical laboratory, such as microbiology, chemistry, hematology, blood banking, and urology. Include types of fluid samples and test that are performed in each area with a detail of the precautions involved when handling each. (TN Reading 3, 4; TN Writing 6)

20) Understand principles of and successfully perform skills of a phlebotomist, incorporating rubrics from National HOSA, textbooks, or clinical standards of practice.
   a. Distinguish sites and/or veins for blood draws in all populations using the required equipment and safety precautions.
   b. Perform collection procedures for microspecimens and venipuncture on a mannequin using appropriate collection containers and identifying factors affecting collection/test results.
   c. Provide guidelines for obtaining blood from neonates, pediatrics, and geriatrics.
   d. Perform skills of patient/specimen identification and transporting of specimens. (TN Reading 3, 4)

Ophthalmological Procedures

21) Outline the in-depth normal structure and function of the eye. Summarize appropriate medical text(s) in order to list signs and symptoms of common diseases and disorders associated with each. (TN Reading 2, 4, 9; TN Writing 8, 9; TN A&P 3)

22) Understand principles of and successfully perform skills related to basic ophthalmic examination, incorporating rubrics from textbooks or clinical standards of practice. Measure pulse and blood pressure, and conduct a history and physical, especially concerning areas related to the eye. (TN Reading 2, 3, 4; TN Writing 8, 9; TN A&P 3)

23) Research the concepts surrounding measurement of visual acuity with associated equipment, and explain corrective measures for abnormalities (i.e., surgery, glasses, or contacts). Specify what measures should be used with each abnormality. (TN Reading 2, 3, 4, 5)

24) Develop a policy and procedure guide for a clinic dealing with frame dispensing, frame alignment and adjustment, and use of a lensometer. Perform skills of assisting a patient to choose the correct frames and correctly adjust for optimal wear. (TN Reading 3, 4)

Special Studies/Procedures

25) Compare and contrast the costs of basic and advanced procedures in each of the following areas of diagnostic medicine: radiological, medical laboratory, diagnostic cardiovascular, gastrointestinal, and respiratory. Explain the purpose for each procedure and distinguish among situations in which a diagnostician would recommend an advanced procedure versus situations in which the basic procedure would be sufficient. Justify the need for the more advanced procedure as would a diagnostician explaining options to a paying patient. (TN Reading 2, 3, 4, 9; TN Writing 1, 4, 6, 8, 9)

26) Generate a digital or written artifact explaining the diagnostic procedures related to gastrointestinal, cardiovascular, pulmonary, and neurological disorders. Include in the explanation the anatomy involved with the procedure, the type of procedure (i.e., invasive or non-invasive), the reason for the procedure, the healthcare staff that will be assisting or performing the procedure, precautions related to the procedure, and any specific patient teaching that should occur prior to administering the procedure. (TN Reading 1, 2, 4, 8; TN Writing 2, 6, 9)

Portfolio

27) Update materials from coursework to add to the portfolio started in *Health Science Education*. Continually reflect on coursework experiences and revise and refine the career plan generated in the prior course. ~~(TN Writing 2, 4, 5)~~

The following artifacts will reside in the student's portfolio:
- Career exploration portfolio
- Skills performance rubrics
- Documentation of job shadowing hours
- Examples of written, oral, or digital presentations
- Short research project documents

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Physics: Tennessee Science: Physics standards 5 and 6 may provide additional insight and activities for educators.~~
- ~~TN A&P: Tennessee Science: Anatomy and Physiology standards 2, 3, 4, and 5 may provide additional insight and activities for educators.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- National Accrediting Agency of Clinical Laboratory Sciences (NAACLS): Standards for Specific Approved Programs
  - Note: Students must be a completer of a NAACLS approved program in order to sit for a national phlebotomy certification exam.

Anatomy and Physiology

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5991
Prerequisite(s):	Prerequisites: *Biology I* (3210) and *Health Science Education* (5998); Pre- or co-requisite: *Chemistry I* (3221)
Credit:	1-2 credits**
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses. It can also count as a science credit and is accepted by the NCAA as a science course.
Programs of Study and Sequence:	This is the third course in *Biotechnology Research, Diagnostic Services, Therapeutic Nursing Services,* and *Emergency Services* programs of study, and the fourth course in the *Therapeutic Clinical Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are available dual credit/dual enrollment opportunities for this course. For more information, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Anatomy and Physiology is an upper level course designed to develop an understanding of the structures and functions of the human body, while relating those to knowledge and skills associated with pathophysiology. Upon completion of this course, proficient students will be able to (1) apply the

Approved January 30, 2015; Amended April 15, 2016

gross anatomy from earlier courses to a deeper understanding of all body systems, (2) identify the organs and structures of the support and movement systems, (3) relate the structure and function of the communication, control, and integration system, and (4) demonstrate a professional, working understanding of the transportation, respiration, excretory, and reproduction systems. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Biology II, Anatomy and Physiology, and Chemistry II, and Advanced Placement Biology standards.*~~

Program of Study Application

This is the upper level course in the *Biotechnology Research*, *Diagnostic Services*, *Therapeutic Nursing Services, Emergency Services*, and *Therapeutic Clinical* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

**Standards marked with the double asterisk (**) serve as extension standards to be taught if course is offered for two credits.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety guidelines appropriate for the roles and responsibilities of employees in healthcare and medical research settings. Listen to safety instructions and be able to explain why certain rules apply. Demonstrate safety techniques and follow all policies and procedures as directed by Occupational Safety and Health Administration (OSHA) guidelines. ~~(TN Reading 2, 3, 4)~~

Organization of the Human Body

2) Review the definition of anatomy and physiology (A&P) from previous courses, identifying the sections, planes, and regions with associated organs in each. In the review, explain using correct medical terminology why the body is organized into systems and how the cellular building blocks (atoms, molecules, cells, and tissue) work together to form each of the organs. ~~(TN Reading 2, 4, 5; TN Writing 4, 9; TN Biology II 1)~~

3) Examine the structures, components, and functions of a typical cell, and explain their actions in movement across cell membranes such as diffusion, osmosis, filtration, active transport, endocytosis, exocytosis, phagocytosis, and pinocytosis. Predict abnormalities that can occur with disorders of cell structures from professional journals or textbooks. ~~(TN Reading 1, 3, 4, 9; TN Writing 9; TN Biology II 1; AP Biology E.U. 2, 3.A)~~

4) Discuss in an oral, written, or digital format the inorganic and organic compounds that are found in living organisms. Describe the consequences if there is a disturbance in any of the following: acid-base balance, change in oxygen and/or carbon dioxide levels, water balance, electrolytes, carbohydrates, lipids, and proteins. ~~(TN Reading 1, 2, 4, 9; TN Writing 4; TN Biology II 3)~~

5) **Synthesize in a written, oral, or verbal presentation the composition and actions of deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and adenosine triphosphate (ATP). Determine how DNA is involved in the genetic code, and describe the importance of chromosomes, the function of RNA as a messenger, and the role of ATP in energy transfer. (TN Reading 1, 2, 8; TN Writing 2, 4, 9; TN Biology II 3, 4; AP Biology E.U. 3.A)

6) **Define the following terms and formulate a hypothesis related to their chromosome aberration abnormalities: polyploidy, tetraploidy, autosomal aneuploidy, sex chromosome aneuploidy, and abnormalities of chromosome structure. (TN Reading 4; TN Biology II 4; AP Biology E.U. 3.A)

7) Explain how organisms use positive and negative feedback mechanisms to maintain their internal environment and respond to external environmental changes. Identify possible consequences that can occur if the body does not maintain homeostasis. Summarize how cellular metabolism can affect the body's homeostatic state. (TN Writing 2, 9; TN Writing 4; TN Biology II 5; AP Biology E.U. 2.B)

Support and Movement

8) Create a model with a written, digital, or verbal explanation of the three layers of skin (epidermis, dermis, and subcutaneous). Summarize functions and characteristics of each layer; describe layers within epidermis and dermis; outline and sketch cell types and definitions, appendages, blood supply, innervation, and possible lesions. (TN Reading 2, 4, 7; TN Writing 4, 9; TN Biology II 1)

9) Investigate and obtain information on a skin disorder/disease/syndrome from a medical/healthcare journal or textbook. Appraise a sample case study involving review of the A&P of the cells and tissues affected. Decide whether an inflammatory response was involved, identify the causative agent, locate signs and symptoms of the disorder, and relate to normal A&P. (TN Reading 1, 2, 4; TN Writing 4, 9; TN Biology II 1)

10) Synthesize information from textbooks or other biological resources on the elements of bone tissue, including bone cells (osteoblasts, osteocytes, osteoclasts), bone matrix (collagen fibers, proteoglycans, cone morphogenic proteins), and glycoproteins (sialoprotein, osteocalcin, calcium, phosphate, alpha-glycoprotein) with the functions of each. Identify bone minerals and determine how they can change these elements during bone development. (TN Reading 1, 2, 4; TN Writing 4, 9; TN Biology II 1)

11) Provide an accurate summary of the chief characteristics of bones, drawing on textbooks, digital resources, and observations. Examine a model (live, virtual, or graphic) of a bone. Describe how the body maintains bone integrity through remodeling and repair. (TN Reading 4, 5; TN Biology II 1)

12) Explain the structure and function of joints in the body by distinguishing among the three classifications (synarthrosis, amphiarthrosis, diarthrosis). Detail the bones involved in each joint, supply examples, and summarize the methods by which joints assist in movement. In addition, be able to locate and describe joint-related structures such as tendons, ligaments, bursae, and cartilage. Summarize what happens to joints when cartilage erodes. (TN Reading 1, 4; TN Writing 2, 9)

13) Label on a skeleton the names of the bones for each of the following, identifying points of attachment:
   a. Skull 22 bones (cranium 8, facial 14)
   b. Spinal Column/Vertebra 24 with explanation of three parts of a typical vertebra (body, foramen, and processes)
   c. Thoracic Cavity
   d. Upper extremities: Shoulder girdle, arms, wrist, and hands including long bone processes, and three parts of each finger
   e. Lower extremities: hip girdle, legs, ankles, and feet including long bone parts, and parts of toes
   (TN Reading 1)

14) Classify the three categories of muscle fibers, differentiating between cells and tissue. Draw evidence from informational texts to explain the locations, behavioral properties, and functional roles unique to each category. Draw on knowledge of biological processes, such as the body's conversion of ATP into energy, to illustrate phenomena such as muscle fatigue. (TN Reading 2, 4; TN Writing 4, 9; TN Biology II 1)

15) **Differentiate between the characteristics of white muscle and red muscle fibers, including their relationship to fast-twitch and slow-twitch fibers. Debate in class or in a written or digital format the purpose of these two types of muscle fibers as related to muscle strength, power and endurance for fitness/athletic training, and rehabilitation of muscle. (TN Reading 2, 4; TN Writing 1, 6, 7)

16) **Describe the motor unit of the skeletal muscle. Explain how the motor neuron within that motor unit communicates with the muscle cells, how muscle contraction is influenced by protein filaments and the physiological principle of the all-or-none law. (TN Reading 2, 4; TN Writing 4; TN Biology II 6)

17) Explain the guidelines used in naming skeletal muscles, such as location, size, direction, etc. Develop a graphic that identifies the name of the muscle, the directional motion, location, and function of the following muscle groups:
   a. Muscles of facial expressions
   b. Muscles of mastication
   c. Muscles of the neck
   d. Muscles of the trunk and upper extremities
   e. Muscles of lower extremities
   (TN Reading 2, 4, 6)

18) **In an informational essay drawing on multiple peer-reviewed articles, explain the connection between the muscular and skeletal systems, particularly as it concerns posture and movement. Demonstrate knowledge of each independent system by comparing and contrasting roles and functions, while describing the symbiosis between them. (TN Reading 1, 2, 4; TN Writing 2, 4, 9)

19) **Research alterations of musculoskeletal function in the areas of skeletal trauma, support structure injuries, metabolic bone diseases, infectious bone diseases, bone tumors, joint disorders, muscle membrane abnormalities, metabolic muscle disease, inflammatory muscle diseases, and/or muscle tumors. Using correct medical terminology, explain in a written, digital, or oral format the following aspects as they relate specifically to musculoskeletal function:

abnormal anatomy and/or physiology, pathophysiology, underlying causation, clinical manifestations, evaluation, and treatment. Differentiate between the diseases in a pediatric, adult, and elderly person. (TN Reading 1, 2, 4, 8; TN Writing 1, 6, 9)

Communication, Control and Integration

20) Differentiate between the central nervous system and the peripheral nervous system, detailing the anatomy of each system, important functions, differences between afferent, efferent, and associative neurons, and the different categories of nervous cells and tissue. (TN Reading 1, 4; TN Writing 2, 9, TN Biology II 1)

21) Explain the process of action potentials of the nervous system and name the factors that affect the speed at which a nerve impulse travels. Include in the explanation the all-or-none law and substances that can change the transmission such as amino acids, monoamines, acetylcholine, etc. (TN Reading 2, 9; TN Writing 4, 9; TN Biology II 6)

22) Describe the location, structures, and primary functions of the anatomical parts of the central nervous system. Explain the importance of cerebral spinal fluid and its connection to circulation, the phenomenon of the blood-brain barrier within the brain, and white and gray matter in the brain. (TN Reading 2, 4; TN Writing 4, 9)

23) Describe the location, structures, and primary functions of the anatomical parts of the peripheral nervous system (PNS). Differentiate between the structures and functions of the cranial nerves, spinal nerves, sympathetic nerves, and parasympathetic nerves. Determine how the phenomenon of biofeedback relates to the structures of the PNS. (TN Reading 2, 4; TN Writing 4, 8)

24) **Gather relevant information from multiple resources related to how the action of catecholamine will vary with different types of neuroreceptor stimulation. Identify the actions of the autonomic nervous system neuroreceptors, the effector organ or tissue, the adrenergic effect, and the cholinergic effect. Link this information to the processes of vasoconstriction and vasodilation in an informational artifact. (TN Reading 2, 4, 9; TN Writing 4, 8, 9)

25) **Complete a literature review of at least three peer-reviewed articles to summarize the research surrounding theories of pain, especially concerning the neuroanatomy of pain, the concept of pain threshold, and pain tolerance. Include a discussion on the perception of pain in pediatric, the aged, males, and females. Cite the information obtained in an informational essay to share with a focus on addressing the perception with someone in the medical community, using appropriate medical terminology. (TN Reading 1, 2, 4, 6; TN Writing 2, 4, 5, 7, 8)

26) Gather information concerning the sensory system. Synthesize the information surrounding the structure and function of the eye, ear, nose, and mouth. Explain the processes of vision, hearing, smell, and taste. Conduct a short research project to give details on how these systems are influenced by the nervous system or the muscular system. (TN Reading 1, 2, 8, 9; TN Writing 4, 7)

27) Define key terms associated with vision disorders, ear disorders, nose disorders, and mouth disorders. Write a case study based on one of these disorders using appropriate medical

terminology, describing the typical profile of a person suffering from the selected disorder. (TN Reading 1, 2, 4, 8, 9; TN Writing 2, 9)

28) **Research from medical resources the alterations in function of the eyes, ears, nose, and throat. In a written, digital, or oral format, explain the following using correct medical terminology: a) abnormal anatomy and/or physiology, b) pathophysiology, c) underlying causation, d) clinical manifestations, e) evaluation, and f) treatment. Differentiate between the diseases in an infant, pediatric, adult, and elderly person. (TN Reading 1, 2, 4, 8; TN Writing 2, 8, 9)

29) List the structures of the endocrine system, explain the functions of each, describe the hormones related to each structure, and summarize the positive and negative effects on the body. Debate in a written or oral format the effects of human growth hormone use in athletes. (TN Reading 1, 2, 6, 9; TN Writing 1, 4, 9)

30) **Research information to explain the pathophysiology and abnormal anatomy and/or physiology surrounding the hypo- and hyper-secretion of hormones of the endocrine system. Explain how these abnormalities can affect one's physical and mental health. Describe how these diseases manifest themselves in different ways in pediatric, adult, and elderly persons. Develop a public service announcement, community awareness presentation, or health education presentation to inform a selected audience about one of these diseases or disorders, following National HOSA competitive events guidelines. (TN Reading 2, 7, 8; TN Writing 4, 6, 7, 9)

Transportation and Defense

31) Identify the liquid and cellular components of blood using appropriate medical terminology. Summarize the structural characteristics, normal levels, function, and life span of each. Evaluate the information to explain how and where each component is manufactured (i.e., as with hematopoiesis and erythropoiesis) and what happens if there are complications with the development. (TN Reading 1, 4, 9; TN Writing 9; TN Biology II 1)

32) **Define hemostasis and explain the related mechanisms that involve the vasculature, platelets, and blood proteins. Relate how clotting factors assist with hemostasis, and describe the complications that arise if there is an abnormality with one of these factors. (TN Reading 1, 2, 5; TN Writing 4)

33) Illustrate in a digital or 3D format the process of inflammation that occurs when tissue has been damaged in the body. Synthesize the inflammatory response process within the circulatory system using medical terminology, then translate information into a brochure that can be provided to a pediatric or geriatric patient. Use phrases and explanations that can be easily understood by each group. (TN Reading 2, 4, 7, 9; TN Writing 6)

34) Describe the roles of antigens and antibodies in the blood while explaining the ABO system and Rh classification system. In a lab setting with simulated blood, determine the ABO and Rh with an explanation of results written in a scientific method format. (TN Reading 2, 3, 4, 8; TN Writing 4, 6)

35) Outline the structure and functions of the anatomy of the cardiovascular system, paying special attention to the musculature of the walls, the chambers, and the valves of the heart and blood vessels. Locate and demonstrate the circulation of blood through the heart; describe the phases and importance of the cardiac cycle and how heart rate and cardiac output relate to one another. Listen to heart sounds, either digitally or with a stethoscope, to identify the normal and abnormal sounds made during the cardiac cycle. Explain the causes for abnormal sounds encountered. (TN Reading 2, 3, 4, 5; TN Writing 2, 4, 9)

36) **Differentiate among the systemic, coronary, hepatic portal, pulmonary, cerebral, and fetal circulation systems, formulating an original hypothesis on possible changes in physiology and pathology in response to new environments and/or stimuli. (TN Reading 2, 8; TN Writing 8, 9)

37) **Describe each part of the conduction system of the heart and its related function. Interpret an electrocardiograph (ECG) of a normal sinus rhythm, identifying the P, Q, R, S, and T waves with an explanation of the electrical and mechanical event of each. Identify ECG strips with explanation of sinus, junctional, and ventricular arrhythmias. (TN Reading 1, 2, 4, 9; TN Writing 4)

38) **Develop an informational fact sheet on diseases of the cardiovascular system. Include in the fact sheet the definition of the disease, the signs and symptoms, diagnostic procedures, underlying causation, clinical manifestations, evaluation, and treatment. (TN Reading 2, 4, 6; TN Writing 4, 5)

39) Describe in a written, oral, or digital format the structure and function of the lymphatic system, lymphatic vessels, and lymph nodes. Differentiate between the cells of the immune response and other defenses, and explain how they work with antigens, antibodies, and individual immunity to maintain homeostasis in the body. (TN Reading 2, 4; TN Writing 4, 9)

40) **Explain from research in peer-reviewed professional journals and/or textbooks the effects of aging on the lymphatic and immune systems, including discussion of the diseases or disorders that can occur. (TN Reading 1, 2, 8, 9; TN Writing 4, 7)

41) **Investigate and explain, citing evidence from textbooks, professional journals, and/or websites, the mechanisms surrounding allergic response, autoimmune, and alloimmune diseases. Explain what systems are involved in the responses and any preventive measures that can be initiated. (TN Reading 1, 2, 4, 8; TN Writing 2, 4, 9)

Respiration, Nutrition, and Excretion

42) Review case studies that involve persons with respiratory disorders, diseases, or syndromes. Citing information from the review, explain the expected anatomy involved and what abnormality is present; and outline normal and abnormal physiology, pathophysiology, preventive measures, and diagnostic procedures for identification of the disease/disorder. (TN Reading 1, 2, 6, 8, 9; TN Writing 2, 4, 9)

43) Define Boyle's Law and the relationship of ventilation, external respiration, internal respiration, and the overall process of gas exchange in the lungs and tissue. Correlate the neural and chemical factors in the control of inspiration and expiration. Identify normal and abnormal lung sounds, explaining the structures responsible for the sounds. (TN Reading 1, 2, 4; TN Writing 4)

44) Trace food from the time it enters the body until it is released, outlining the organs involved and the digestive processes that occur. (TN Reading 1, 2, 4, 5)

45) **Compare and contrast Basal Metabolic Rate (BMR) and Basal Metabolic Index (BMI). Calculate the BMR and BMI for multiple weights and explain the significance of BMI measurement on the health of individuals. Develop a meal plan for someone who has a BMI greater than 24.5 in order to reduce risk of diabetes, heart disease, or stroke. (TN Reading 2, 4, 9; TN Writing 4, 8)

46) **Research medical texts and peer-reviewed journals to explain the pathophysiology and abnormal anatomy and/or physiology surrounding diseases, disorders, and/or syndromes of the digestive system. Explain how these abnormalities can affect one's physical health, outlining signs and symptoms, underlying causation, clinical manifestations, diagnostic procedures, evaluation, and treatment. Differentiate between the diseases in a pediatric, adult, and elderly person. Develop a public service announcement, community awareness presentation, or health education presentation to inform a selected audience about one of these diseases or disorders using the National HOSA competitive events guidelines. (TN Reading 1, 2, 4, 6, 8; TN Writing 2, 4, 6)

47) Design a concept map of the structures of the urinary system, complete with associated explanations of the functions of each structure. Predict possible complications for each structure and outline methods to prevent the complications. (TN Reading 2, 4; TN Writing 4, 9)

48) Identify the internal and external anatomy of the kidney. Analyze the blood supply that is required for functioning, the physiology of the nephrons, the process by which urine is formed, the pathways for excretion in males and females, and the chemical and nervous system control of urinary secretion. (TN Reading 2, 4, 5)

49) **Investigate how the urinary system interacts with other body systems. Provide descriptions of the anatomy and physiology involved and possible complications that might arise with an imbalance. (TN Reading 2, 4, 5)

50) **Research the pathophysiology and abnormal anatomy and/or physiology surrounding diseases, disorders, and/or syndromes of the urinary system. Explain how these abnormalities can affect one's physical health, outlining signs and symptoms, underlying causation, clinical manifestations, diagnostic procedures, evaluation, and treatment. Differentiate between the diseases in a pediatric, adult, and elderly person. (TN Reading 1, 7, 8, 9; TN Writing 4, 8, 9)

Reproduction, Growth, and Development

51) Outline the structure and function of the male reproductive system. Include information about the anatomy of the spermatozoa, the ducts of the system, accessory glands, and semen. (TN Reading 1, 2, 4; TN Biology II 6)

52) Summarize in a written, verbal, or digital format the structure and function of the female reproductive system, and the hormones that affect the multiple stages of the menstrual cycle. (TN Reading 1, 2, 4; TN Writing 4, 6; TN Biology II 6)

53) Evaluate and provide evidence of the process of fertilization, mitosis, and meiosis, then outline the timeline and phases of development of a fetus, from fertilization until birth. Describe the abnormalities that can occur at each phase, including genetic disorders and other congenital complications. (TN Reading 1, 2, 4; TN Writing 4, 8; TN Biology II 4, 5, 6)

54) **Research and develop a public service announcement or public health presentation to inform high school students and young adults of the various types of sexually transmitted diseases. Provide informative and factual details concerning complications, signs and symptoms, preventive measures, and treatments available for diseases discussed. (TN Reading 1, 2, 9; TN Writing 4, 6, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Biology II: Tennessee Science: Biology II standards may provide additional insight and activities for educators.
- TN Chemistry II: Tennessee Science: Chemistry II standards may provide additional insight and activities for educators.
- TN A&P: Tennessee Science: Anatomy and Physiology standards may provide additional insight and activities for educators.
- AP Biology: Advanced Placement Biology standards may provide additional insight and activities for educators.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Biomedical Applications

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5992
Prerequisite(s):	*Diagnostic Medicine* (5994)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses. Satisfies one laboratory science credit in the area of life sciences.
Programs of Study and Sequence:	This is a fourth course option in the *Biotechnology Research* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Biomedical Applications is a capstone course designed to prepare students to pursue careers in the fields of biotechnology research. This course combines advanced methods and technologies with the scientific principles that comprise today's emerging biomedical fields. Upon completion of this course, proficient students will be able to identify careers in these fields, describe their scientific foundations,

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research technologies and development in all areas of healthcare, and relate how these technologies are transforming many disciplines and impacting society at large. In addition, students will conduct an ongoing original research project or experiment on an emerging biotechnology application of their choice. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee state standards in Biology II and Chemistry II, and Advanced Placement Biology standards.**~~

Program of Study Application

This is a capstone course option in the *Biotechnology Research* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at http://www.tn.gov/education/cte/HealthScience.shtml.

Course Standards

Scientific Foundations

1) Differentiate between the terms biotechnology and biomedicine, noting the impact that each has had on society. Explore the history and development of these scientific fields, as well as the roles that their associated industries have played in the areas of agriculture, manufacturing, health and medicine, the environment, global society and the economy, and forensics. ~~(TN Reading 1, 2, 9; TN Writing 4, 8, 9)~~

2) Review the structural organization of all living things at the cellular level. Summarize in an oral, written, or digital presentation how cellular organization influences scientific approaches to biotechnology and biomedicine, with specific attention given to the various levels of eukaryotic organisms, cellular molecules, proteins, and nucleic acids. ~~(TN Reading 2, 9; TN Writing 4, 6, 8, 9; TN Biology II Standard 1; AP Biology E.U. 2.B, 2.E, 3.A)~~

3) Synthesize information from professional journals and/or websites, textbooks, and news articles to compare and contrast the structure and properties of the four macromolecules (carbohydrates, lipids, proteins, and nucleic acids). Describe in an informational artifact how the cell membrane structures may be manipulated to allow the passage of these macromolecules in a cell; relate how this knowledge is used by scientists and applied to biotechnology research. ~~(TN Reading 1, 2, 5, 9; TN Writing 4, 7, 8, 9; AP Biology E.U. 2.A, 2.B)~~

4) Distinguish between a number of strategies used to isolate or clone a gene, such as activation tagging, map-based gene cloning, plasmid cloning vectors, viral vectors, and shuttle vectors. Present an overview of these strategies in a visual format. ~~(TN Reading 2, 9; TN Writing 4, 6, 9; AP Biology E.U. 3.A, 3.C)~~

5) In an argumentative essay, state claims and counterclaims about how DNA structure and function may be exploited using modern genetic engineering methods to produce specific genetic constructs, such as selecting, excising, ligating, and cloning of genetic material. Ensure the documentation is written in domain-specific medical terminology. ~~(TN Reading 2, 4, 9; TN Writing 1, 4, 8, 9; AP Biology E.U 3.B)~~

6) Define the terms DNA replication, DNA transcription, and translation of mRNA. Recount the processes involved in each and describe the negative outcomes if there is an interference in the process. Using domain-specific terminology, develop a scientific explanation to support the claim that the structures and mechanisms of DNA and RNA are the primary sources of heritable information. (TN Reading 2, 9; TN Writing 9; AP Biology E.U. 3.A)

7) Construct a visual model, annotated with written explanations, detailing how DNA in chromosomes is transmitted to the next generation via mitosis or meiosis. Note qualitative and quantitative traits, mutations, transposable genetic elements, and regulation of gene expressions. (TN Reading 2, 4, 9; TN Writing 4, 6, 7, 9; AP Biology E.U. 3.A)

8) Research and explain Mendel's model of inheritance. Using this model, trace the pattern of appearance within a family for a heritable disease that is on the recessive allele and one that is on the dominant allele. Develop an argumentative essay regarding how a certain biotechnology could genetically modify a gene to prevent this disorder, citing information from textbooks and/or professional journals and websites. (TN Reading 2, 3, 4, 9; TN Writing 1, 4, 8, 9; AP Biology E.U. 3.A, 3.B.)

Technologies and Development

9) Investigate and develop a digital, oral, or written presentation on the current and emerging applications of biotechnology and biomedicine, such as bionic prosthesis, nanotechnology, and stem cell research. Cite textual evidence from science or professional journals, websites, and textbooks to explain how the new technologies have contributed to the advancement of diagnostics, therapeutics, genetic mapping, and disease predictions and determinants. (TN Reading 1, 2, 4, 7, 9; TN Writing 2, 4, 6, 8, 9; AP Biology E. U 3.D, 3.B.)

10) In an argumentative essay, provide justification for the following statement: "Humans can manipulate heritable information by at least two commonly used technologies in biomedicine" (AP Biology Essential Knowledge, learning objective 3.5). Cite information from professional peer-reviewed articles, textbooks, and/or other scientific journals to support claims. (TN Reading 1, 2, 4, 9; TN Writing 1, 4, 8, 9; AP Biology E.U. 3.A)

11) Investigate the ethical, social, and medical issues surrounding the research of biotechnology and biomedicine. Debate the claims and counterclaims of the issue in a written or oral format, including aspects such as protecting human subjects from harm or death, affordability of research, privacy of subjects, and the promotion of lifesaving research. (TN Reading 3, 4; TN Writing 4, 9; AP Biology 3.B)

12) Review the use of volume measuring devices commonly used by biotechnologists, such as pipettes, micropipettes, and glassware. Prepare solutions and appropriate media, then perform serial dilutions incorporating aseptic techniques. (TN Reading 3, 4; TN Chemistry II 3)

13) Explain in depth the terms and phrases often heard in a biotechnology or biomedical laboratory: quality assurance, quality control, method validation, appropriate documentation, current good manufacturing practices, and good laboratory practices. Relate how these terms and practices are important in the safe development of biomedical/biotechnology products and services. (TN Reading 3, 4; TN Writing 4, 9; TN Chemistry II 3)

Safety

14) Review guidelines from governmental agencies such as the Office of Safety and Health Administration (OSHA) guidelines for medical and research laboratories, OSHA guidelines for Standard Precautions and personal protective equipment, Safety Data Sheets (MSDS) and storage of reagents and compounds, and Environmental Protection Agency (EPA) laboratory guidelines. Compare and contrast the rules and regulations of each agency to develop clear expectations regarding the maintenance of safety in these laboratories. (TN Reading 2, 4, 9; TN Writing 4, 8, 9)

15) Develop a safety manual for a biological or chemical laboratory, specifically for a lab that is involved with processing or developing biomedical products. Include the following in the manual: safety guidelines, procedures for accident prevention and response, and steps for reporting and documenting hazards. Explain the industry standards to maintain aseptic and sterile procedures and luminary flow, as well as the purpose of biosafety cabinets. Draw on the standard operating procedures from agencies such as OSHA, EPA, and Centers for Disease Control and Prevention (CDC) when developing the manual. (TN Reading 2, 4, 9; TN Writing 4, 5, 6, 8, 9)

Methods and Applications

16) Differentiate between the terms electrophoresis, blotting, and polymerase chain reaction. Explain how each is used in DNA cloning or sequence identification, and describe the procedures involved with each. Relate how these terms and procedures apply to biotechnology. Compare and contrast the advantages and disadvantages of one method over the other. (TN Reading 2, 4, 9; TN Writing 4, 8, 9; AP Biology E.U. 3.C)

17) Summarize the historical background and chief purpose of the Human Genome Project. Discuss in the summary the sequence technology utilized and the method for assembly of the draft genome. Then, chart the status of the model organisms such as Arabidopsis, yeast, mouse, fruit fly, rat, nematode, Escherichia coli, and higher plant models. Report the impact that the Human Genome Project has had on medicine to date, and explain what the future holds for the project. (TN Reading 2, 4, 7, 8, 9; TN Writing 4, 8, 9; AP Biology E.U. 3.A., 3.B., 3.C)

Perceptions and Future

18) Summarize research from professional journals or websites, textbooks, and/or newspaper articles surrounding an ethical issue related to biotechnology (i.e., the use of animals for lab testing, genetically modified organisms, or stem cell use). Debate the chosen topics, presenting both sides of the issue. Discuss the moral, ethical, and legal responsibilities of researchers, policymakers, and other actors as they pertain to informing the public and ensuring the safety and well-being of affected populations. (TN Reading 1, 2, 4, 6, 8, 9; TN Writing 4, 5, 8, 9; TN Biology II 1; AP Biology E.U. 3.A. 3.B)

19) Develop an original idea for a new biotechnology product, and simulate a situation in which the product must be pitched to a prospective client. Create an informational packet to share during the presentation that includes the following items: definition and protection of intellectual

property, type of patent, copyright issues and rules, trademarks, and breeders' rights for plants or animals. (TN Reading 2, 3, 4, 9; TN Writing 2, 4, 6, 7, 8, 9; TN Biology II 1)

20) Develop an argumentative essay surrounding public perceptions and attitudes toward the use of biotechnology in society. Develop claims and counterclaims thoroughly based on facts from research, pointing out the strengths and weaknesses of each claim. Document information using appropriate industry terminology, including areas such as federal and international regulation and oversight, safety assessment, labeling of products, and impact on the economy. (TN Reading 2, 4, 9; TN Writing 1, 4, 5, 8, 9; TN Biology II 1; AP Biology 3.A, 3.E)

21) Understand principles of, and successfully perform skills related to, the biomedical laboratory. Document findings from skills utilizing appropriate medical terminology. Incorporate rubrics from textbooks, National HOSA guidelines, or clinical standards of practice for the following:
   a. Correct use of an ultraviolet/visible spectrophotometer
   b. Application of principles of electrophoresis and demonstration of skills to separate and identify DNA fragments based on size
   c. Thin-layer Chromatography (TLC)
   d. Isolation of DNA, establishing quantity, quality, and purity
   e. Demonstration of PCR procedures
   f. Conducting a qualitative enzyme-linked immunosorbent assay (ELISA)
   g. Bacterial transformation
   (TN Reading 3, 4, 9; TN Writing 4, 7, 9; TN Chemistry II 1, 3; AP Biology 3.A, 3.B., 3.C., 3.E, 4.A)

Capstone Project

22) Using the scientific method, design a scientific research project or experiment to investigate biotechnology applications in healthcare, industry, environment, agriculture, forensics, or related fields. Summarize the findings in an original research paper or lab report, citing evidence to support conclusions from professional journals and websites, textbooks, and original observations. In addition to the research paper, develop a PowerPoint, tabletop, or poster presentation to deliver before a classroom or community audience. Incorporate the following steps when carrying out the project or experiment (possible topics are listed at the end of this document):
   a. Research to determine the task or topic
   b. Exploration of the task or topic
        i. Literature review
       ii. Collection and evaluation of sources
   c. Thesis/hypothesis proposal and annotated bibliography
   d. Revision and final draft of thesis/hypothesis
   e. Outline/plan of action for paper or experiment
   f. Data collection/development of research ideas and narratives
   g. Submission of first draft of paper/lab report
   h. Feedback, revision, and submission of final draft
   i. Reflection and evaluation
   (TN Reading 1, 2, 4, 6, 7, 8, 9; TN Writing 2, 4, 5, 6, 7, 8, 9; TN Chemistry II 1, 3; AP Biology 3.A, 3.B., 3.C., 3.E)

Standards Alignment Notes

**References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Biology II: Tennessee Science: Biology II standards may provide additional insight and activities for educators.~~
- ~~TN Chemistry II: Tennessee Science: Chemistry II standards may provide additional insight and activities for educators.~~
- ~~AP Biology: Advanced Placement Biology standards may provide additional insight and activities for educators.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Notes

Possible topics for the capstone project include:
1) Biotechnology in healthcare
    a. Diagnostic applications
    b. Therapeutics and pharmaceuticals (gene therapy)
    c. Bioinformatics to predict disease and determine treatment
    d. Genetic mapping
    e. Genetic counseling
    f. STEM cell research and use
2) Industrial applications
    a. Bioprocess
    b. Microbial growth
    c. Bioreactors
    d. Water treatment
    e. Animal pharming (i.e., the use of plants and animals to make pharmaceuticals)

3) Environmental applications
    a. Bioremediation
    b. Waste management
    c. Phytoremediation

d. Biocontrol
4) Agriculture
    a. Plants
    b. GMOs
    c. Insect resistance
    d. Viral resistance
    e. Herbicide resistance
    f. Nutritional quality
5) Animal food biotechnology
    a. Growth hormones
    b. Cloning of animals
    c. Aquaculture
    d. Microbiology in foods
6) Bioterrorism/biotechnology disaster
    a. Agent payload
    b. Dispersal mechanisms
    c. Biological/chemical weapons
    d. Artificial viruses
7) Forensic science
    a. DNA
    b. Mechanisms to prevent crime
    c. Image enhancement technologies
    d. Data mining

Cardiovascular Services

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6131
Prerequisite(s):	*Diagnostic Medicine* (5994) and *Anatomy and Physiology* (5991, 3251) (pre- or co-requisite)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the fourth course in the *Diagnostic Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Certified Cardiogenic Technician (CCT) after graduation with completion of appropriate clinical experience.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Cardiovascular Services is an applied course in the *Diagnostic Services* program of study intended to prepare students with an understanding of the roles and responsibilities of those seeking employment in the cardiovascular field of healthcare. Upon completion of this course, proficient students will have a thorough understanding of the anatomy and physiology of the heart and be knowledgeable about both

invasive and non-invasive cardiovascular procedures. Students will incorporate communication, goal setting, and information collection skills to be successful in the workplace. Students who complete a *Clinical Internship* in addition to this course will be eligible upon graduation to sit for the Certified Cardiographic Technician (CCT) exam; relevant standards are indicated below with (CCT). Standards in this course are aligned with English Language Arts & Literacy in Technical Subjects as well as Tennessee Anatomy and Physiology standards.*

Program of Study Application

This is the fourth course in the *Diagnostic Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Career Planning

1) Research careers within cardiovascular and pulmonary sciences and explain in a graphic illustration or informational artifact** the educational/credentialing requirements, scope of practice, as well as state and national compliance guidelines required of cardiovascular health care professionals. (TN Reading 2, 7, 9)

2) Analyze the range of skills, competencies, and professional traits (such as leadership, time management, and ethical responsibility) required for careers in cardiovascular or pulmonary sciences. Using real-time and projected labor market data, identify local and national employment opportunities and determine areas of growth. Complete a job application, resume, and cover letter for one of the jobs located in the search. (TN Reading 2; TN Writing 4, 6, 8, 9)

Legalities and Ethical Issues

3) Summarize the Health Insurance Portability and Accountability Act (HIPAA) and explain procedure and guidelines concerning receiving and verifying physician orders, identifying the patient/client, and obtaining patient's consent to perform procedures. Identify the procedures that require written permission and those that require only verbal consent. Role-play these procedures in a classroom and/or clinical setting. Explain, using domain-specific language and accurate definitions of legal concepts, how the content of these legal documents impacts patients' rights for all aspects of care. (TN Reading 1, 2, 4, 5)

4) Compare and contrast the costs of preventive medical procedures versus diagnostic medical procedures related to the cardiovascular and pulmonary system. Use information found in news media, professional journals, and trade magazines to help determine if preventive procedures would increase or decrease health care cost as it relates to heart health. (TN Reading 1, 9; TN Writing 2, 8, 9)

Anatomy and Physiology

5) Outline the gross and cellular structure and function of cardiac, circulatory, pulmonary, and autonomic systems. Include the following areas:
   a. Electrophysiology of the heart, including definitions of waveforms
   b. Control mechanisms and cardiac cycle with normal values (CCT)
   c. Size, location, layers, chambers, valves, pressures, and blood flow of heart (CCT)
   d. Relationship of cardiac output to heart rate and stroke volume (CCT)
   (TN A&P 1, 3, 4)

6) Interpret the pathophysiology related to normal and abnormal heart sounds and breath sounds. Evaluate simulated heart sounds to identify normal heart sounds, normal lung sounds, murmurs, rubs, extra heart sounds, wheezes, or other abnormal breath sounds via a mannequin or digital substitute. (TN Reading 3; TN A&P 1, 3, 4)

7) Choose a disease, disorder, or emergency situation related to the cardiac, circulatory, pulmonary, or autonomic systems drawn from news media, textbooks, professional journals, or trade magazines. Develop an oral or visual presentation interpreting the scope of the disease/disorder/emergency, basic pathophysiology, affected populations, pharmacological interventions, signs and symptoms, risk factors, existing practices that target the disease/disorder, and interventions available. (TN Reading 1, 2; TN Writing 2, 8, 9; TN A&P 1, 3, 4)

8) Formulate a written and digital health education project to inform an adult and/or geriatric audience about the negative effects of complications such as electrolyte imbalance, obesity, hypertension, diabetes, or renal impairment on the heart, circulatory, and pulmonary systems. (TN Reading 2; TN Writing 6, 8)

Diagnostics and Procedures

9) Perform the following duties and tasks related to pre-procedural activity: (CCT)
   a. Perform universal precautions (e.g., hand washing, Personal Protective Equipment)
   b. Transport the patient
   c. Prepare the patient (shaving, cleaning skin, etc., should be simulated on mannequin)
   d. Collect patient information
   e. Enter information into Electrocardiogram (ECG) machine
   f. Identify proper landmarks on mannequin
   g. Maintain patient safety throughout the pre-procedural process
   h. Vital sign assessment
   i. Pulse oximeter
   (TN Reading 3)

10) Differentiate between bipolar, unipolar, and precordial leads. Relate their importance in performing an ECG test correctly. Include the concept of Einthoven's Triangle in the explanation. (TN Reading 1, 2, 3, 5; TN A&P 1, 3, 4)

11) Compare and contrast the single- and three-channel ECG machines. Demonstrate the ability to define the purpose of the equipment, and explain indications for use, expected outcomes, advantages, disadvantages, and limitations of each. (TN Reading 1, 2, 3, 5)

12) Summarize the history of the ECG machine including aspects of industry standardization and advances in technology. Use a timeline or other graphic to illustrate the major developments. (TN Reading 2, 7; TN Writing 6, 8)

13) Understand principles of and successfully perform skills related to performing a resting ECG (12 lead, 15 lead, etc.), incorporating rubrics from textbooks or clinical standards of practice for the following: (CCT)
   a. Gather supplies and equipment
   b. Educate patient on procedure expectations
   c. Apply electrodes and leads to patient
   d. Confirm equipment
   e. Perform standard ECG
   (TN Reading 1, 3, 5)

14) Obtain ECG tracing strips and perform rhythm analysis, including the following: (CCT)
   a. Analyze ECG tracing for presence of P, Q, R, S, and T waves, heart rate calculation, and axis determination and implications.
   b. Identify ECG tracings indicative of sinus, junctional, atrial, ventricular, atriaventricular, hypertrophy, chamber enlargement, and pacemaker rhythms. Include intraventricular conduction and myocardial perfusion tracings.
   c. Identify electrical interference and somatic tremor on an ECG tracing, as well as the steps to take to alleviate or prevent such artifacts.
   d. Correlate ECG finding (wavelengths, segments, intervals, etc.) with cardiac function.
   e. Correlate ECG morphology with anatomy and physiology.
   (TN Reading 1, 3, 5, 7; TN A&P 1, 3, 4)

15) Role-play explanation of the cardiovascular reflex test in a mock clinical setting. Discuss at minimum the following: overview or explanation of the test, the associated risks, patient expectations before, during, and after the test, and next steps for abnormal results. (TN Reading 1, 2)

16) Summarize in a written, oral, or digital presentation the scope of a typical electrocardiograph test. Draw evidence from textbooks, professional journals, and online healthcare sites (such as Cleveland Clinic, MedLine Plus, and Mayo Clinic) to produce an overview or explanation of the test, the associated risks, and patient expectations before, during, and after testing. (TN Reading 1, 2; TN Writing 2, 4, 6, 8, 9)

17) Construct a chart or a graph that differentiates between the various types of nuclear imaging and the radiographic cardiovascular and pulmonary test. Include within this graph or chart an overview or explanation of the test, the mechanics of the procedure, the associated risks, and patient expectations before, during and after testing. Obtain information from textbooks, professional journals, and online healthcare sites (such as Cleveland Clinic, MedLine Plus, and Mayo Clinic). (TN Reading 1, 2; TN Writing 2, 4, 6, 8, 9)

18) Research the types of invasive diagnostic procedures. Examples might include cardiac catherization, carotid angiography, electrophysiological studies, intravascular ultrasound, or myocardial biopsy. Develop a patient education packet utilizing medical and non-medical terminology, including the following information: overview or explanation of the procedure, the

associated risks, patient expectations before, during, and after the test, and next steps for abnormal results. (TN Reading 1, 2; TN Writing 2, 4, 6, 7, 8, 9; TN A&P 1, 4)

19) Differentiate between the various types of cardiovascular ultrasound procedures. Discuss what an ultrasound can identify that other procedures might not, in addition to the risk considerations, reliability of results, and proper interpretation of an ultrasound image. Role-play teaching another classmate about the type of procedure that has been ordered by the physician. (TN Reading 1, 2; TN Writing 2, 4, 6, 8, 9; TN A&P 1, 4)

Invasive Treatment Procedures

20) Research treatments involving cardiac, vascular, and thoracic surgery for cardiovascular and pulmonary diseases and/or disorders. Analyze in written, oral, or digital format the implications for each, identifying trends and/or advances in available treatments over the past fifty years. (TN Reading 1, 2, 4; TN Writing 2, 6, 8, 9; TN A&P 1, 4)

21) Identify characteristics and/or signs and symptoms of patients experiencing cardiac and/or pulmonary complications in physician offices or emergency rooms. Create a plan of action for assessment, diagnosis, and treatment of the patient. (TN Reading 1, 3; TN Writing 2, 8, 9; TN A&P 1, 4)

Health Statistics

22) The Centers for Disease Control (CDC) suggests that the number one leading cause of deaths in the United States is heart disease, according to 2012 data. Complete a short research project to identify on the local level the 1) incidence of heart disease and disorders, 2) number of associated deaths, 3) preventive measures currently being taken, and 4) available educational programs and initiatives. Document findings in an oral, digital, or visual presentation. Information can be found from organizations such as the CDC, state and county health department websites, and interviews with public health and emergency professionals. (TN Reading 1, 2, 7; TN Writing 2, 6, 7)

23) Research the Healthy People Initiative sponsored by the U.S. Food and Drug Administration (FDA). Identify the goals and objectives, established baselines, and strategies to facilitate progress toward the initiative's goals. Then, develop a marketing campaign to inform a variety of audiences about the initiative. The campaign can include a public service announcement, community awareness project, health education project, and/or public health education project shared with local schools, leaders in the community, and the general public. (TN Reading 1, 2, 7, 9; TN Writing 2, 6, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).

- o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course. Teachers are encouraged to develop extension activities to cover standards 6 and 8.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course. Teachers are encouraged to develop extension activities to cover standard 1.
- TN A&P: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Science, Human Anatomy and Physiology.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Standards Notes

**Informational artifacts include, but are not limited to, brochures, posters, fact sheets, narratives, essays, and presentations. Graphic illustrations include, but are not limited to, charts, rubrics, drawings, and models.

Behavioral and Community Health

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6130
Prerequisite(s):	*Emergency Preparedness* (6151)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the third course in the *Public Health* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/article/mathematics-standards.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	577, 720, 722
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Behavioral and Community Health is an applied course for students interested in developing a rich understanding of the ways that communities experience and treat health-related issues. Upon completion of this course, students will be able to use research and data to understand the health and wellness of his/her community, state, region, and nation; differentiate between health and wellness; relate that knowledge to social epidemiology and determinants of health; draw key connections

Approved April 10, 2015; Amended April 15, 2016

between behavioral health issues and community health issues; and identify professionals who can provide care. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the third course in the *Public Health* program of study and builds knowledge and skills necessary for success in the capstone course, *Global Health and Epidemiology*. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Overview of Healthcare History, Systems, and Legislation

1) Gather relevant information from multiple sources (in both print and digital formats) concerning the history of, and relationships between, community health, disease outbreaks and psychosocial disorders in order to understand how community health has formed the basis of the modern healthcare system. Research notable historical figures, time periods, and/or practices to develop a visual, oral, and/or written presentation that cites specific textual evidence to support analysis. ~~(TN Reading 1, 5, 7; TN Writing 4, 6, 8, 9)~~

2) Differentiate between health, healthcare, and healthcare systems/organizations related to community and mental health, and explain their evolution in modern society. Use information from governmental agencies, such as the Center for Disease Control and Prevention (CDC), to identify health disparities (for example, rates of childhood obesity in different regions) in the United States population. Physically locate care-providing organizations and agencies that can be utilized to address identified disparities. ~~(TN Reading 1; TN Writing 7)~~

3) Define epidemiology and identify social and community health issues prevalent in a specific community. Research social determinants impacting a specific health issue, including but not limited to age, behavior, race/ethnicity, environment, geography, social status, income, and other factors that contribute to diseases and disorders. Summarize findings in a graphic illustration or informational artifact in order to participate in a discussion comparing and contrasting health of communities with different demographic data. ~~(TN Reading 1, 7; TN Writing 8)~~

4) Research and summarize major state and federal legislation related to behavioral and community health using both primary sources (such as laws) and secondary sources (such as media reports). Construct an argumentative essay describing the effects of these laws on the provision of healthcare in Tennessee and the implications for at-risk populations. In the essay, compare and contrast findings presented in media about legislation, citing specific textual evidence to support a claim and assess extent to which reasoning and evidence may support or refute identified counterclaim(s). ~~(TN Reading 1, 2, 8, 9; TN Writing 1, 8, 9)~~

Careers

5) Research careers within the public health and mental health fields and document educational requirements as well as state and national guidelines governing practicing professionals (such as licensing, certifications, training, compliance). Identify potential training programs, schools, and examinations appropriate to obtain required credentials for a specific occupation. (TN Writing 2, 7, 8, 9)

6) Research and summarize the range of skills, competencies, and professional traits required for careers in the public health and mental health fields. Compare findings to current individual strengths and identify opportunities for personal development. Translate real-time and projected labor market data into narratives to identify local and national employment opportunities and determine areas of growth within public health and mental health fields. (TN Reading 2, 7; TN Writing 4, 6, 8, 9)

Legal and Ethical Issues

7) Compare and contrast the specific laws and ethical issues that impact relationships among patients/clients and healthcare professionals (for example, patient confidentiality). Citing specific textual evidence to support reasoning, participate in a verbal or written debate as related to behavioral and community health by developing claim(s) and counterclaim(s). (TN Reading 1, 9; TN Writing 1, 4, 8, 9)

8) Research the Americans with Disabilities Act of 1990 (ADA), the American Hospital Association's "Patient Bill of Rights," the Omnibus Budget Reconciliation Act of 1990 (OBRA), and the Patient Self-Determination Act of 1990 (PSDA). Explain to a patient/client or classmate the rights of a patient or client, depending on differences in age, mental status, and competency. Cite the above documents in clear, coherent language to describe the relationships among concepts of patient rights. (TN Reading 2, 5)

9) Summarize the Health Insurance Portability and Accountability Act (HIPAA) within the context of mental health and community health treatment, and relate key provisions of the act to patient rights. Develop a brochure or factsheet, which can be shared with minors, adults, and non-English speaking individuals that defines key words and phrases, illustrates key points, and cites specific textual evidence from the act. (TN Reading 1, 2, 4, 7; TN Writing 6)

10) Construct an argumentative essay contrasting patient/client rights with a community's right to know about dangerous mental health clients or persons with communicable diseases, citing evidence from legislation and news articles to support claim(s) and counterclaim(s). (TN Reading 1, 8, 9; TN Writing 1)

11) Research sections of the Patient Protection and Affordable Care Act of 2010 (ADA) related to community health and preventive medicine, synthesizing a variety of professional, journalistic, and medical perspectives on the ramifications of the act for individuals and communities. Select one of the preventive guidelines listed in the prevention/wellness section of the law and develop a plan to implement it for a given community. For example, to increase access to fresh produce, a plan may include a gap analysis, list of stakeholders, budget, and timeline for activities using domain-specific language. (TN Reading 1, 2, 4; Writing 2, 8, 9)

Social Perception and Prevalence of Diseases and Disorders

12) Assess the costs associated with providing long-term care to patients/clients with mental or chronic conditions. Compare and contrast these costs against alternative treatment methods such as institutionalization or preventative care. Incorporate evidence from the Long-Term Care section of the Patient Protection and Affordable Care Act of 2010 (ADA), The Mental Health Parity and Addiction Equity Act of 2008, TennCare guidelines, and rates quoted by competing insurance companies. (TN Reading 9)

13) Evaluate health data from a range of sources (such as the World Health Organization, Centers for Disease Control and Prevention) to determine the social perception and prevalence of chronic, mental, and environmental health diseases and disorders. Research should incorporate relevant health indicators, clinical trials, risk factors, and clinical perspectives using domain-specific language. Prepare a graphic illustration to summarize findings in clear, coherent language, citing specific textual evidence. (TN Reading 1, 2, 4, 7)

14) Choose a health parameter relevant to a particular population of interest (such as heart disease in males and Alzheimer's in females) using multiple print and digital professional, scholarly and news resources. Develop an informative/explanatory text discussing the scope of the disease/disorder, affected and vulnerable populations, local incidence information as compared to state, region, and national data, existing policies or plans that target the disease/disorder, and healthcare interventions available. (TN Reading 1, 2; TN Writing 2, 7, 8, 9)

15) Investigate stigmas surrounding mental health and illness, obesity, smoking, drug abuse, and other public health issues in the community. Develop a public service announcement (PSA) or presentation to build awareness and understanding of the disease/disorder, addressing common misconceptions, outlining signs and symptoms, and providing strategies for management or containment. (TN Reading 2, 7; TN Writing 6, 8)

Mental Health Issues

16) Distinguish among the different domains of psychology, including but not limited to biological, clinical, cognitive, developmental, educational, experimental, and industrial-organizational domains. Articulate in a verbal, written, or digital format the key features, methodologies, basic assumptions, applications, and strengths and weakness of each domain. (TN Reading 2, 4; TN Writing 2, 9)

17) Differentiate the signs and symptoms of common psychobiological disorders, including anxiety disorders, depressive disorders, bipolar disorders, eating disorders, cognitive disorders, additive disorders, personality disorders, sleep disorders, and factitious and dissociative disorders. Investigate available treatments and scientific research regarding the management of different psychobiological disorders. Research at least one historical and one modern case study and discuss the implications for the health of communities citing specific textual evidence from the case studies. (TN Reading 1, 2, 9; TN Writing 2, 8, 9)

18) Research trauma interventions for dealing with crisis and disaster, suicide, anger, aggression and violence, and physical, emotional, and sexual abuse. Identify major legislation that has been recently changed or developed in response to the prevalence of trauma in society and

hypothesize outcomes of legislation. Test hypotheses using case studies. (TN Reading 2; TN Writing 1, 7, 8, 9)

Treatment and Therapeutic Communication

19) Examine the various treatment methodologies prescribed for mental and chronic health issues and explain why certain diseases and disorders call for different types of treatment, including but not limited to pharmacological regimens, changes in diet and exercise, counseling, and different types of therapy. (TN Reading 4, 5; TN Writing 2, 9)

20) Develop a detailed treatment plan with goals and objectives, medications, and/or alternative treatment and coping mechanisms for each of the mental conditions or chronic health issues studied in this course. Compare and contrast medications and treatments using medical documentation and cite specific textual evidence to defend elements of plan. (TN Reading 1, 9; TN Writing 2, 9)

21) Research and apply concepts of therapeutic communication in a mock scenario role-play surrounding a psychobiological or traumatic situation. (TN Reading 3)

22) Research, identify, and define the steps involved in psychiatric therapeutic holds and the skills necessary to apply Crisis Prevention Intervention techniques when dealing with someone in a mental health crisis using accurate medical terminology. Role-play these skills in a classroom for patients/clients experiencing one of the diseases or disorders identified in the course. (TN Reading 3, 4; TN Writing 9)

23) Synthesize the knowledge acquired in this course to draw connections between mental illnesses/disorders with broader issues affecting the health of communities. In a sustained research project, examine how families and neighborhoods can change as the result of chronic or acute incidents of trauma, such as generational poverty or acts of terrorism, and discuss the implications for community structure, family dynamics, and financial stability when mental health issues are prevalent within a community. Develop, edit, and revise a detailed plan to alleviate the effects of one such issue on a community, incorporating written, oral, and digital components to support the presentation of the plan. (TN Writing 2, 4, 5, 6, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6 and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Global Health and Epidemiology

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code:	6132
Prerequisite(s):	*Behavioral and Community Health* (6130)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Public Health* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720, 722
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Global Health and Epidemiology is a comprehensive applied course in the *Public Health* program of study that places students at the intersection of health science and health policy. This course investigates the patterns, causes, and effects of diseases in a variety of populations, and how the provision of healthcare has changed in response to global needs. Successful international strategies and programs will be examined. Upon completion of this course, proficient students will be able to interpret and communicate statistical information relating to the distribution of disease and mortality/morbidity

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in the United States and globally, determine national and international health disparities, analyze national and international health policies, and evaluate outcomes from a range of health interventions. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee state standards in Anatomy and Physiology.*~~

Program of Study Application

This is the fourth and final course in the *Public Health* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Introduction to Global Health and Epidemiology

1) Define global health and epidemiology, discussing in detail why these fields should be studied, the principles and goals of each, and the concept of health citizenship in the context of disease prevention and health management. Determine the differences between field, clinical, and chronic epidemiology. ~~(TN Reading 4, 9)~~

2) Research the various agencies and organizations, including transnational and non-governmental organizations (NGOs), involved in the study of global health and epidemiology.** Examine their roles as they relate to policymaking, research, program implementation, and/or monitoring and evaluation work. Organize the information into a visual, oral, and/or written presentation, citing examples of these actors' impact on global health initiatives drawn from reports, legislation, press releases, or other public documents. ~~(TN Reading 1, 5, 7; TN Writing 4, 6, 8, 9)~~

3) Investigate careers within the fields of epidemiology and global health. Outline the educational requirements for each career as well as state and national guidelines governing practicing professionals (such as licensing, certifications, training, and compliance). Create and maintain a document detailing potential training programs, schools, and examinations suitable for obtaining required credentials for a specific occupation. ~~(TN Writing 2, 7, 8, 9)~~

4) Research and summarize the range of skills, competencies, and professional traits required for careers in the epidemiology and global health fields. Compare findings to current individual strengths and identify opportunities for personal development. Translate real-time and projected labor market data into narratives to identify local and national employment opportunities and determine areas of growth within epidemiology and global health fields. ~~(TN Reading 2, 7; TN Writing 4, 8, 9)~~

5) Gather relevant information from professional journals, news media, and trade magazines (in both print and digital formats) concerning the history of global health and epidemiology. Develop a visual, oral, and/or written presentation describing notable historical figures and pioneers who have made significant contributions in disease recognition, treatment, and prevention. ~~(TN Reading 1, 7, 9; TN Writing 4, 6, 8, 9)~~

6) Define the terms endemic, epidemic, and pandemic. Analyze the factors involved in the spread of disease, such as the increase in world travel among socially mobile populations. Research global initiatives currently in place to prevent the spread of diseases/disorders such as influenza, Pertussis, or HIV/AIDS. (TN Reading 4, 9)

Biostatistics

7) Public health surveillance is a mechanism that public health agencies use to monitor the health of communities. Describe the types of data commonly collected by global health organizations and government agencies, including the key parameters (i.e., fertility, life expectancy, infant mortality rates) most often reported in the analysis of public health. Demonstrate the ability to interpret and communicate results from public health surveillance analyses, applying basic statistical concepts such as measurements of central tendency (mean, median, mode), measurements of spread (range, variance, standard deviation), and changes over time. (TN Reading 1, 2, 4, 8, 9; TN Writing 2, 4, 9; TN Mathematics S-ID)

8) Relate how biostatistical data is used to identify global health priorities, disparities, and epidemiological transitions, and discuss how advances in public health surveillance have changed the delivery of key healthcare services (such as the need for family planning, vaccinations, or disease treatment). Furnish examples of data-driven policy changes informed by the collection and analysis of health surveillance data. For example, examine a case study of how the World Health Organization responded to the global SARS outbreak of 2004. (TN Reading 1, 2, 9; TN Writing 2, 9)

9) Compare and contrast the average cost of healthcare in the United States with that of other countries, according to indices compiled by the Organization for Economic Cooperation and Development (OECD). Drawing on a range of public health surveillance data, examine the correlations between average cost and key parameters such as government involvement, availability of insurance, per capita spending, hospital admission rates for chronic diseases, and mortality rates for cervical and colorectal cancer, for example. (TN Reading 1, 4, 7, 9; TN Writing 4, 7, 8, 9; TN Mathematics N-Q, S-ID, S-IC)

10) Citing research, news media, and scholarly commentary, discuss the factors that may contribute to the relationship between the cost of care and health of communities. (TN Reading 1, 2, 7, 9; TN Writing 4, 7, 8, 9; TN Mathematics N-Q, S-ID, S-IC)

11) Differentiate between descriptive epidemiology and analytical epidemiology research designs, and demonstrate the ability to recognize different methodological approaches as applied to a range of public health studies/reports. Explain the information gathered in each type of study and how that information is important when planning changes in healthcare. (TN Reading 1, 2, 5, 8; TN Writing 4, 8, 9)

Disease Causation and Control

12) Choose a communicable or non-communicable disease or disorder prevalent in the United States. Using the Centers for Disease Control and Prevention (CDC) Vital and Health Statistics report, describe the occurrence or frequency of the disease across various demographic categories such as sex, age, race/ethnicity, educational attainment, family income, poverty level,

health insurance coverage, marital status, and place of residence. Compare findings with data from a country with a similar prevalence of the disease. For example, examine the prevalence of heart disease in the United States as compared to Ireland. Compile the information into an electronic presentation. Support the interpretation of findings with graphical depictions of the data gathered. (TN Reading 1, 5, 7; TN Writing 4, 6, 8, 9)

13) An important aspect of the study of epidemiology is to identify factors that place certain populations at a higher risk for developing diseases and disorders. Compare and contrast the two primary models of disease causation: the epidemiologic triad and Rothman's causal pies. Debate the pros and cons of each in a written, oral, or electronic format. (TN Reading 2, 4, 5; TN Writing 1, 4)

14) Assess the impact that environmental factors, such as natural and unnatural disasters, can have on a range of global health issues. Discuss the implications for disease prevention, containment, and control when environmental conditions are considered. (TN Reading 2, 9; TN Writing 8, 9)

15) Examine the epidemiology, mortality, morbidity, genetic, and/or biological basis of at least one of the diseases or disorders in each of the areas listed below. Compare the prevalence of the disease/disorder across a variety of populations and countries. Drawing on skills learned in biostatistical analysis, determine the factors that contribute to higher or lower prevalence in a given population or country.
   a. Infectious Diseases
   b. HIV/AIDS
   c. Neurodevelopment disabilities
   d. Cancer
   e. Cardiovascular Disease
   f. Diabetes
   g. Dementia
   (TN Reading 1, 2, 3, 7, 8, 9; TN Writing 7, 9; TN Mathematics S-ID, S-IC, S-CP)

16) Compare and contrast the health challenges characteristic of urban and rural settings. Analyze factors such as disease management, social and behavioral interventions, nutrition, service disparities, and availability of preventive measures like screenings. Debate the key challenges to the provision of services across a variety of global settings. (TN Reading 1, 2, 9; TN Writing 9)

17) Investigate the causes of child/infant mortality within the first five years of life worldwide. Identify effective interventions for prevention of infant and childhood disorders, supporting recommendations with evidence-based medical or public health practice standards retrieved from the kinds of sources described in this course. (TN Reading 1, 2, 9; TN Writing 4, 7, 8, 9)

18) Explain the 10 steps of an outbreak investigation. As part of a group project, analyze a mock scenario in which the CDC has been called to investigate the outbreak of a foodborne, airborne, windborne, or waterborne disease in the United States or abroad. Determine the scope of the outbreak, identify the specific populations affected or endangered by it, and assign roles and responsibilities to contain and/or eradicate the disease. Drawing on resources used in this course, make recommendations based on hypothetical findings, protocols, and policies.*** (TN Reading 2, 4, 7, 9; TN Writing 2, 4, 7, 8, 9; TN Mathematics S-ID)

Health Policy

19) Research and summarize current policies related to global health in the areas of disease prevention, treatment and control, and educational campaigns. For each of these areas, examine the involvement of relevant national and transnational actors identified in standard 2. Construct an informational or explanatory essay that describes major historical events associated with current policies, evaluates the roles of the actors involved, and interprets public opinion and industry commentary on the impact of the policies to date. (TN Reading 1, 2; TN Writing 2, 8)

20) Synthesize the standards of practice concerning health and human rights in the Universal Declaration of Human Rights and the Constitution of the World Health Organization. Compare and contrast the documents for principles related to health, human rights, and humanitarian aid. Examine case studies where human rights and public health are intertwined, such as the refugee crisis caused by the civil war in Syria dating from 2011. (TN Reading 2, 5, 9; TN Writing 9)

21) Research advocacy strategies used to support global health initiatives. Identify the major decision-makers and stakeholders involved in the promotion and implementation of health policies, ranging from the provision of maternal care in under-resourced areas to the administration of humanitarian aid in regions of armed conflict. Discuss the political and transnational process around implementing quality health policies for populations in need. (TN Reading 2, 5, 6, 9; TN Writing 9)

22) Drawing on material learned in this course, conduct a needs assessment for a target population affected by a health issue such as diabetes, cancer, HIV/AIDS, or other disease/disorder. Retrieve relevant health surveillance data related to the prevalence of the disease/disorder and the environmental and genetic factors that contribute to the problem. Synthesize research on existing policies, programs, and initiatives currently or formerly in place to alleviate the problem, and compile the results of the needs assessment into a written report supported by graphical and statistical aids. (TN Reading 1, 2, 3, 7, 8, 9; TN Writing 2, 4, 7, 8, 9; TN Mathematics S-ID, S-IC, S-CP)

23) Building off the needs assessment conducted in standard 21, create a plan to address the needs of the target population. Consider a range of potential policy solutions, weighing the costs and benefits of each, including the obstacles to implementation. Then advance a recommendation for one of the solutions, outlining a strategy to engage the appropriate agencies, decision-makers, and other stakeholders. (TN Reading 7, 9; TN Writing 1, 4, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Statistics and Probability, Modeling.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate statistical reasoning as applied to specific technical concepts. In addition students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN A&P: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Science, Human Anatomy & Physiology.~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in TN Anatomy and Physiology 6.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Notes

**Major agencies and organizations include, but are not limited to: the World Health Organization (WHO), the United Nations, the Pan American Health Organization (PAHO) and the International Committee of the Red Cross (ICRC).

***Resources suggested for the mock outbreak project include:
- CDC Outbreak Investigation Overview for Vessel Sanitation Program: http://www.cdc.gov/nceh/vsp/surv/investigationoverview.htm
- CDC Current Outbreak List: http://www.cdc.gov/outbreaks/
- Epidemiological Investigation of Outbreaks: http://www.gov.mb.ca/health/publichealth/cdc/protocol/investigation.pdf

Medical Terminology

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5883
Prerequisite(s):	None
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This course is included in the *Diagnostic Services, Health Informatics, Emergency Services,* and *Therapeutic Clinical Services* programs of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are available dual credit/dual enrollment opportunities for this course. For more information, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720, 721, 722
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Medical Terminology is a course designed to provide students with the opportunity to develop working knowledge of the language of healthcare professionals. Students will acquire vocabulary-building and problem-solving skills by learning prefixes, suffixes, roots, combining forms, and abbreviations commonly used in medical fields. Utilizing a body systems approach, students will define, interpret, and pronounce medical terms relating to structure and function, pathology, diagnosis, clinical procedures, and pharmacology. Upon completion of this course, proficient students will be able to apply problem-

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solving skills to the documentation of medical phenomena and will be able to communicate fluently in the language of medicine when working in healthcare settings. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee Anatomy and Physiology standards.*~~

Program of Study Application

This course appears in the *Diagnostic Services, Health Informatics, Emergency Services,* and *Therapeutic Clinical Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

1) Interpret the historical development of the medical language, illustrating the Latin and Greek origination of the medical terms used today. In an informational artifact, detail the importance of historical events in medicine and their relationship to modern medical language.** ~~(TN Reading 1, 2, 4; TN Writing 2, 8)~~

2) Identify and explain the definitions and roles of the four types of word parts (word roots, combining forms, combining vowels, suffixes, and prefixes) in forming medical terms. Apply knowledge of word forms and structures to interpret unfamiliar medical terms throughout this course. Research the origins of eponyms; then differentiate between medical eponyms, acronyms, and abbreviations. ~~(TN Reading 1, 4, 9; TN Writing 8, 9)~~

3) Research and summarize the precautions surrounding the use of abbreviations and symbols within the healthcare profession. Explain and demonstrate the importance of clear, proper documentation when filling out a patient/client chart or other patient document. For example, explain why using appropriate abbreviations is so important when prescribing the correct dosage for a patient's medication (i.e., writing "mg" for milligrams). ~~(TN Reading 1, 2, 4, 5, 6, 9; TN Writing 2, 4, 8)~~

4) Examine a professional medical journal or mock patient document specifically related to an unfamiliar disease, phenomenon, diagnosis, or area of medical research. Demonstrate the ability to locate medical terms and define the prefixes, suffixes, abbreviations, and symbols in order to arrive at a professional understanding of the topic discussed. Interpret and synthesize the text into an original summary, review, or other written or verbal analysis of the topic, showing mastery of unfamiliar terms. ~~(TN Reading 1, 2, 4, 5, 6; TN Writing 4, 8, 9)~~

5) Evaluate multiple evidenced-based research articles. Document in an informational artifact the correlation of diseases and/or disorders discussed in the articles with terminology associated with anatomical positions, body planes, cavities, directional terms, body systems, and symbols. ~~(TN Reading 2, 4, 9; TN Writing 7, 8, 9)~~

6) Analyze and interpret vocabulary related to pathology, diagnostic, and therapeutic medical terms, as well as abbreviations of the body systems below, by evaluating professional texts

featuring such terms. Demonstrate mastery of medical terminology use and accurate spelling in each area through verbal and written explanation.

    a. Cells, tissues, and glands
    b. Genetics
    c. Integumentary
    d. Respiratory
    e. Cardiovascular
    f. Musculoskeletal
    g. Endocrine
    h. Nervous
    i. Lymphatic/immune and hemolytic
    j. Gastrointestinal
    k. Urinary
    l. Special senses
    m. Reproductive
(TN Reading 1, 2, 4, 6, 7, 9; TN Writing 2, 4, 8, 9; TN A&P 2, 3, 4, 5, 6)

7) Interpret, analyze, and accurately spell vocabulary linked to diagnostic procedures and pharmacology in the following areas: therapeutic services, diagnostic medicine, biotechnology services, emergency medical services, cardiovascular services, and dental services. Demonstrate the skills involved when interpreting a prescription or complex diagnostic procedure by explaining the terminology, abbreviations, and symbols to a classmate in language that is more familiar and easy to understand. (TN Reading 2, 3, 4, 6, 7, 9; TN Writing 2, 4, 8, 9)

8) Research a current medical, legal, or ethical issue found within professional and/or peer reviewed journals. Develop an informative or persuasive article, report, or research paper documenting the concepts and perspectives surrounding the issue. When writing, include appropriate medical terminology and apply conventional citation methods used in medical literature. For example, investigate current debates surrounding stem cell research and argue for whether this line of research benefits the medical community and society at large; or, document the increase in mental health diagnoses and the impact this phenomenon has on the population. Cite all sources used in the course of the research, review, and revise writing as needed. (TN Reading 1, 2, 4, 6, 7, 9; TN Writing 1, 2, 4, 5, 6, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Notes

**Informational artifacts include but are not limited to brochures, posters, fact sheets, narratives, essays, and presentations. Graphic illustrations include but are not limited to charts, rubrics, drawings, and models.

Health Information Technology

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code:	5997
Prerequisite(s):	*Medical Terminology* (5883)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the third course in the *Health Informatics* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	A statewide dual credit challenge examination exists for this course for students to earn dual credit at Tennessee public postsecondary institutions that offer health science. For more information, please visit http://www.tn.gov/education/opca/.
Teacher Endorsement(s):	577, 720, 721, 722
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Health Information Technology is a third-level applied course in the *Health Informatics* program of study intended to prepare students with an understanding of the changing world of health care information. With the inclusion of electronic medical records, electronic billing, and electronic prescriptions, students

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in all healthcare professions must increasingly demonstrate competency in health information and health informatics. Upon completion of this course, proficient students will be able to differentiate among the types of health information/informatics, code and manage medical records, retrieve crucial data from health information systems and indexes, and understand the implications for careers in a range of health care fields. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the third course in the *Health Informatics* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Careers

1) Define the broad field of informatics and discuss its increasing importance in health care. Compare and contrast the types of healthcare informatics, such as medical, clinical, biomedical, nursing, public health, and information science. Identify the impact each of these areas of informatics has had on its corresponding sector of healthcare. ~~(TN Reading 2, 7; TN Writing 4, 6, 8, 9)~~

2) Research careers within the healthcare informatics, health information management, and health information technology fields, and document educational requirements as well as state and national guidelines governing practicing professionals (such as licensing, certifications, training, and compliance). Using real-time and projected labor market data, identify local and national employment opportunities and determine areas of growth. Complete a job application, resume, and cover letter for one of the jobs located in the search. ~~(TN Writing 2, 7, 8, 9)~~

3) Compare and contrast the history of health informatics with projected developments and innovations expected in the future. Discuss in an oral, digital, or written presentation the relationship between major issues in healthcare and the changes in health information technology. ~~(TN Reading 2, 8; TN Writing 4, 6)~~

4) Analyze an ethical issue related to health informatics, such as ownership of and access to data, or the debate around respecting the privacy of individuals versus promoting the public good in the disclosure of health threats like HIV/AIDS and avian flu. Relate the findings of the research to the International Medical Informatics Association and American Health Information Management Association (AHIMA) Code of Ethics for Health Information Professionals. ~~(TN Reading 1, 2, 6; TN Writing 2, 9)~~

Medical Records

5) Summarize the purposes and functions of the patient health record. Identify the purpose of each of the following components:
    a. History and Physical
    b. Discharge summary

      c.   Progress notes and orders
      d.   Nursing notes
      e.   Operative reports
      f.   Preoperative and postoperative anesthesia notes
      g.   Pathology reports
      h.   Consultation reports
      i.   Medication administration records
      j.   Consent forms
      k.   Ancillary reports (X-ray, lab, therapy reports)
      l.   Advance Directives (Do Not Resuscitate, living will, power of attorney, specialty records such as in OB, ER, and nursery)
(TN Reading 2, 4, 8; TN Writing 4, 9)

6) Compose a list of clinical health information data points for alternative care settings including but not limited to ambulatory care, behavioral health, stand-alone clinical laboratory, home care, long-term care, stand-alone surgical center, and walk-in/urgent care clinics. For example, list all the typical diagnostic information collected as part of a routine physical. For each setting examined, explain why certain data points are of more interest or importance to the healthcare provider in that particular setting. (TN Reading 2, 3, 4; TN Writing 4, 8, 9)

7) Explain the guidelines surrounding medical record storage, control, and retention as prescribed by local, state, and federal regulations. (TN Reading 2; TN Writing 4, 9)

8) Compare and contrast numbering and filing systems used in health information departments. Differentiate among and be able to retrieve files using the following health record numbering systems: enterprise-wide numbering, unit numbering, serial numbering, and serial-unit numbering. (TN Reading 3, 4; TN Writing 6, 7)

9) Compare and contrast qualitative and quantitate record analysis, then practice the skill of assembling a patient health record. Apply alphabetical, numerical, and terminal digit filing methods to patient records. Analyze the record for completeness and accuracy. (TN Reading 3, 4)

10) Using correct medical terminology and authentication of patient record entries, compare and contrast the standards from external agencies (such as the Joint Commission and AHIMA) and facility policies regarding provider documentation responsibilities. Refer to the American Society for Testing and Materials (ASTM) publication ASTM E2369-12 Standard Specification for Continuity of Care Record. (TN Reading 4, 9; TN Writing 4, 9)

Electronic Health Records

11) Define Electronic Health Record (EHR) and briefly explain its emergence and evolution. Compare the advantages and disadvantages of manual versus automated record systems. Identify barriers and challenges associated with the large-scale move to EHR in healthcare institutions. (TN Reading 2, 9; TN Writing 4, 9)

12) Research how the Affordable Care Act and the American Recovery Reinvestment Act, Public Law 111-5 have impacted the evolution and integration of Electronic Health Records. Citing specific

textual evidence from the laws, together with professional and scholarly commentary, debate whether these changes will benefit consumers and healthcare providers, and analyze the short-term and long-term consequences. (TN Reading 2, 8, 9; TN Writing 1)

Health Information Systems

13) Identify the multiple indexes maintained by health care facilities and state and federal agencies, and create a brief profile of each based on evidence drawn from case studies. Record in the profile the content, significance, purpose, development, and maintenance of indexes such as the master patient index, disease index, and operation index. (TN Reading 2, 9; TN Writing 4, 9)

14) Investigate the major parameters most frequently reported in health databases, including descriptive health care statistics and hospital-based statistics. Review a case scenario involving health care statistics and summarize the statistical information into a bar graph, pie chart, scatterplot, or other graphical representation. Identify the characteristics, units, and standards of each parameter, including applicable medical terminology. (TN Reading 1, 7, 8, 9; TN Writing 4, 6; TN Math N-Q, S-ID)

15) Differentiate between the terms *registries* and *registers* and detail the characteristics of each. Review data from the National Center for Health Statistics (NCHS) in order to develop a vital statistics depiction of a community. Record items such as births per thousand, deaths, fetal death, marriages, divorces, and maternal health information in an electronic spreadsheet or chart. (TN Reading 4, 7, 8; TN Writing 4, 6, 7)

16) Develop a digital or paper presentation to illustrate the purpose, content, and use of registries in the United States, such as:
    a. Tumor Registry
    b. Birth Registry
    c. Trauma Registry
    d. Brain Injury Registry
    e. Implant Registry
    f. Immunization Registry
    g. Diabetes Registry
    (TN Reading 2, 4, 6, 7; TN Writing 4, 6, 9)

Legal Ramifications of Health Information

17) Summarize the Health Insurance Portability and Accountability Act (HIPAA) and applicable state laws to explain methods of ensuring data security and confidentiality by controlling access and release of information. Develop a policy and procedure explaining the process for providing access to health records for a variety of third parties, including but not limited to state licensing boards, court systems (i.e., in the event a subpoena is issued), insurance companies, law enforcement, government agencies, employers, and other health care providers. (TN Reading 2, 4, 8, 9; TN Writing 2, 4, 8)

18) Explain in a written, oral, or digital format the differences in privacy of individually identifiable health information, protected health information (PHI), and security rule. Review case studies to

identify violations, preventive measures, and penalties that might be levied for violations. (TN Reading 2, 4, 8, 9; TN Writing 4, 9)

19) Research major federal and state legislation that has impacted health information management. Identify the law or regulation, the year it was instated, the sponsor(s) of the legislation, a description of its content, any justification provided for its passage, and a case that has used the legislation in the defense on the patient/client's behalf. (TN Reading 2, 8, 9; TN Writing 4)

20) Identify emerging technologies and practices related to health information, such as the use of mobile technologies, consumer outline to health records, and evidenced-based practices. Argue the ethical and legal complications associated with these practices. (TN Reading 2, 4; TN Writing 1, 4)

21) Investigate identify theft and fraud associated with electronic health information. Develop a Public Service Announcement for the elderly or other vulnerable population to alert them to the problems and explain how to prevent fraud or theft of their health care information. (TN Reading 2, 5; TN Writing 4, 6)

Coding and Reimbursement

22) Design a comprehensive teaching brochure for a new patient that explains the multiple sources of reimbursement in healthcare services and how medical records can affect the reimbursement rate. Report on areas such as capitation, Medicare, TennCare, prospective payment systems, Relative Value Resource Based systems (RVRB), case mix, MS-DRGs, healthcare insurance, and accountable care organizations. (TN Reading 2, 4, 7, 9; TN Writing 4, 6, 9)

23) Differentiate between medical nomenclatures and classification systems used for reporting to third-party payers for reimbursement, for data collection, and for education and research. Identify the components of the coding systems, including but not limited to: DSM, CPT, ICIDH, HCPCS Level II, CDT, NDC, ICD-9-CM, and ICD-10-CM. (TN Reading 1, 2, 8, 9; TN Writing 8)

24) The Centers for Medicare and Medicaid Services (CMS) developed the prospective payment System (PPS), payment systems, fee schedules, and exclusions. Explain the payments systems of third-party payers as related to the types of forms they use. Develop a written or visual presentation explaining the differences among the payment systems. (TN Reading 6, 7, 8; TN Writing 4, 6, 8)

25) Compare and contrast the following types of data sets related to medical coding and/or reimbursement: OASIS, HEDIS, UHDDS, DEEDS and MDS 3.0. Explain in an informational text the development of, purpose, advantages, challenges, and health care setting in which each might be used. (TN Reading 2, 3, 4; TN Writing 2, 4, 9)

26) Practice the introductory skills related to coding for diagnosis using the ICD-9 or ICD-10 coding system and CPT coding system for procedures. (TN Reading 3, 4; TN Writing 7, 4)

27) Define the terms related to billing and coding fraud and abuse. Evaluate multiple scenarios to identify fraud and/or abuse and explain how they can be avoided. Cite specific regulations

and/or laws from the Fair Debt Collection Act, HIPAA, and the Privacy Act in the explanation. (TN Reading 1, 2, 4; TN Writing 4, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 1, 3, and 10 at the conclusion of the course.
- TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Statistics and Probability.
  - o Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Clinical Internship

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5993
Prerequisite(s):	Any second level Health Science course
Credit:	1-4
Grade Level:	11-12; *Students must be at least 16 years old to be enrolled in this course.*
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the final course in the *Diagnostic Services, Health Informatics,* and *Therapeutic Clinical Services* programs of study. May be incorporated in *Emergency Services* POS after completion of the *Emergency Medical Services* course, or the *Therapeutic Nursing Services* POS after *Nursing Education*, or *Public Health* POS after *Community and Behavioral Health*.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Refer to http://www.tn.gov/education/cte/HealthScience.shtml for more information.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	Teachers must attend WBL training and earn the WBL Certificate provided by the Tennessee Department of Education in addition to an 8 hour Clinical Internship training.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Clinical Internship is a capstone course and work-based learning experience designed to provide students with real-world application of skills and knowledge obtained in a pre-requisite Health Science

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course. Upon completion of this course, proficient students will be able to pursue certification in the pre-requisite course of *Cardiovascular Services* or *Pharmacological Science* once they have graduated and reached 18 years of age. Prior to beginning work at a clinical site, students must be certified in Basic Life Support (BLS) Cardiopulmonary Resuscitation (CPR), and deemed competent in basic first aid, body mechanics, Standard Precaution guidelines, and confidentiality. Business Management & Administration concentrators may also take this course as part of a career practicum/work-based learning placement within the *Health Services Administration* program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee work-based learning guidelines.~~

Note: Student to teacher ratio for this course is 15:1 in a clinical setting.

Work-Based Learning Framework

Clinical experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. The TDOE provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities. Additionally, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning.

Program of Study Application

This is the final course in the *Diagnostic Services, Health Informatics,* and *Therapeutic Clinical Services* programs of study (POS). This course may also be incorporated in the *Emergency Services* POS after completion of the Emergency Medical Services course, or the *Therapeutic Nursing Services* POS after *Nursing Education*, or *Public Health* POS after *Community and Behavioral Health*. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

1) Accurately read, interpret, and demonstrate adherence to safety guidelines appropriate for the roles and responsibilities of an employee of a healthcare facility. Listen to safety instructions and be able to explain why certain rules apply. Demonstrate safety techniques and follow all applicable facility policies and procedures (such as Standard Precautions) related to the clinical placement. Based on placement, document completion of training topics on the appropriate work-based learning (WBL) and work site forms. ~~(TN Reading 2, 3, 4, 6; TN Writing 4)~~

2) Develop a personalized student-learning plan, in accordance with approved policies, to address the methods for practicing and demonstrating each of the skills identified in the pre-requisite health science course standards. Relate how each skill applies to a placement in a healthcare setting, and document day-to-day applications. Participate in ongoing review and communications around progress of plan with Health Science WBL Coordinator. ~~(TN Reading 1, 2, 3, 4, 9; TN Writing 2, 4, 6, 7, 8, 9)~~

3) Observe and analyze organizational culture and practices. For example, analyze how to interact with supervisors, clients, and co-workers, and how to recognize and address health, safety, and sustainability issues. Seek information from supervisors and other employees about appropriate methods of pursuing employment in the industry, and determine what knowledge, skills, and educational credentials are required. (TN Reading 2, 9)

4) Apply learning experiences from clinical placement to review and update an education and career pathways plan based on the knowledge and feedback acquired. Proactively identify areas of strength and opportunities for professional growth, encourage and act on feedback from peers, supervisors, and customers, and seek and use resources and support to improve skills. (TN Reading 4)

5) Identify and ask significant questions to solve student-identified challenges or areas of improvement in the workplace. Use inductive and deductive reasoning methods to recognize faulty reasoning, and to understand problems and alternative solutions.

6) Analyze patient quality assurance methods used by clinical sites. Solve problems using systems thinking, e.g., by understanding problems in terms of complex processes and environments. Identify key components and relationships that enable, influence, and produce outcomes. (TN Reading 3, 7, 8)

7) Review the Health Insurance Portability and Accountability Act (HIPAA) concepts and investigate methods to assure confidentiality within the healthcare setting. Employ techniques to ensure the client/patient's rights are maintained. (TN Reading 1, 2, 4, 5, 9)

8) Demonstrate integrity and ethical behavior when engaging in all worksite activities, including the use of tools and materials, documentation of hours, handling of money, billing of clients, sharing of information, and completion of all personnel-related forms. Identify an actual or potential work site ethical issue and construct an argumentative essay outlining how to the issue should be resolved, including claims and counterclaims with relevant data to support conclusions. (TN Reading 4; TN Writing 1, 4, 8)

9) Articulate ideas effectively in written personal communications with supervisors, coworkers, and customers using appropriate medical terminology and revising as necessary. Verbally articulate ideas effectively in interpersonal communications with supervisors, coworkers, and customers. Develop and deliver messages effectively in oral presentations. Demonstrate effective listening skills, attending to the meaning and intention of communication, and accurately paraphrasing what has been heard. Communicate effectively with individuals of diverse backgrounds who may also speak languages other than English, using foreign language skills and facility resources as appropriate. (TN Reading 3, 4, 9; TN Writing 4, 5)

10) Work effectively as a member of a team and address conflict with sensitivity and respect for diverse points of view. Demonstrate understanding of one's own impact and build on different perspectives to strengthen joint efforts. Demonstrate leadership where appropriate to collaborate on workplace tasks. Effectively employ meeting management strategies, such as agenda setting, time keeping, and meeting facilitation strategies, and list action items to identify and schedule next steps.

11) Access information efficiently, using sources appropriate to task, purpose, and audience. Distinguish between credible and non-credible sources, including the difference between advertising and legitimate research. Evaluate information for usefulness, bias, and accuracy, and question information that may not originate from credible sources. Demonstrate the ability to organize and manage information effectively and efficiently. Demonstrate ethical and legal use of information, including adherence to all rules and regulations related to sharing of protected information. (TN Reading 2, 3, 4, 9; TN Writing 4, 8, 9)

12) Use appropriate technology in the classroom or clinical setting for information search and retrieval, synchronous and asynchronous communications, multimedia presentations, document production, quantitative and qualitative analysis, and information management. Use social networking and online collaboration tools such as shared documents and web conferencing to create, integrate, and manage information in group projects. (TN Reading 2, 9; TN Writing 6, 9)

13) Access and manage online communication and information, such as electronic medical records, using multiple digital devices such as laptop computers, tablets, smart phones, etc. Demonstrate adherence to all rules and regulations related to the use of electronic tools and the Internet, including appropriate protection of passcodes and adherence to all security protocols. (TN Reading 3, 7, 8, 9; TN Writing 6, 9)

14) Complete tasks as directed with supervision, knowing when to ask questions or request guidance. Exhibit resourcefulness and initiative in taking on new tasks and solving problems independently as appropriate to the workplace setting. Demonstrate how to learn and exhibit personal agency in identifying and achieving instrumental and ultimate learning objectives. Demonstrate curiosity to learn more about the tasks, workplace, and/or industry. Explore deeper content independently and request opportunities for professional development. Demonstrate self-efficacy and confidence in one's ability to succeed in specific situations. (TN Reading 3, 4; TN Writing 8, 9)

15) Exhibit professionalism and respect when interacting with coworkers, supervisors, and customers. Demonstrate reliability and responsibility in attendance and in following through on assigned tasks, and provide timely communication with supervisor(s) when circumstances change. Understand and adhere to appropriate workplace non-discrimination standards on the basis of sex, race, color, age, national origin, religion, disability, marital status, sexual orientation, gender identity, pregnancy, veteran status, or any characteristic of a person or group unrelated to the workplace. Respect cultural differences and work effectively with people from diverse social and cultural backgrounds.

16) Exhibit flexibility by (a) adapting to varied roles, jobs responsibilities, schedules and contexts; (b) working effectively in a climate of ambiguity and changing priorities; and (c) dealing positively with praise, setbacks, and constructive criticism.

17) Manage time and projects effectively by (a) setting goals; (b) developing and using a system for prioritizing, planning and managing daily work; (c) persisting in the face of challenges; and (d) seeking assistance and adjusting plans to adapt to changing circumstances. Demonstrate attention to detail and accuracy appropriate to the task. Demonstrate accountability to supervisors, coworkers, and customers by delivering work to agreed-upon standards; accepting

constructive criticism; completing designated projects on time; and exhibiting pride in workmanship.

18) Update the Health Science student portfolio that illustrates mastery of skills and knowledge outlined in the Health Science pre-requisite course standards and applied in the *Clinical Internship* experience. Compile artifacts and similar work products reflecting thoughtful assessment and evaluation of the progression against goals in the personal growth plan. Artifacts may include:
   - Career and professional development plan
   - Resume
   - Documentation of clinical hours at each site
   - List of responsibilities undertaken throughout the placement
   - Examples of materials developed and used throughout the placement
   - Periodic journal entries reflecting on tasks and activities
   - Supervisor evaluations and observations
   - Approved WBL forms
   - WBL coordinator evaluations and observations
   (TN Reading 1, 3, 4, 9; TN Writing 2, 4, 5, 8, 9)

Standards Alignment Notes

*References to other standards include:
   - TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
      - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
   - TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
      - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3and 10 at the conclusion of the course.
   - P21: Partnership for 21st Century Skills Framework for 21st Century Learning
      - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
   - TN WBL: Tennessee Work-Based Learning Standards

Medical Therapeutics

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5999
Prerequisite(s):	*Health Science Education* (5998)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the second course in both the *Therapeutic Nursing Services* and *Therapeutic Clinical Services* programs of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to your local postsecondary institution.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Medical Therapeutics is an applied course designed to prepare students to pursue careers in therapeutic services. Upon completion of this course, a proficient student will be able to identify careers in therapeutics services; assess, monitor, evaluate, and report patient/client health status; and identify the purpose and components of treatments. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Partnership for 21st Century Skills Framework for 21st Century Learning, as well as Tennessee Anatomy and Physiology standards.*

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Program of Study Application

This is the second course in the *Therapeutic Nursing Services* and *Therapeutic Clinical Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Career Planning and Compliance

1) Research careers within the therapeutic field, and document educational requirements as well as state and national guidelines governing practicing professionals (such as licensing, certifications, training, compliance). Identify potential training programs, schools, and examinations appropriate to obtain required credentials for a specific occupation. (TN Writing 2, 7, 8, 9)

2) Investigate and compare the range of skills, competencies, and professional traits required for careers in the therapeutic field. Compare findings to current individual strengths and identify opportunities for personal development. Translate real-time and projected labor market data into narratives to identify local and national employment opportunities and determine areas of growth within therapeutic health fields. (TN Reading 2, 7; TN Writing 4, 6, 8, 9)

3) Compare and contrast the specific laws and ethical issues that impact relationships among patients/clients and the healthcare professional (for example, patient confidentiality). Citing specific textual evidence to support analysis, debate these issues in an oral or written format. (TN Reading 1, 9; TN Writing 1, 4, 8, 9)

4) Demonstrate understanding of major legislation and policy affecting health care interaction and delivery by explaining to a patient/client or classmate the American Hospital Association's "Patient Bill of Rights"; National Patient Safety Goals; and Joint Commission on Accreditation of Health Organizations (JCAHO). (TN Reading 2)

5) Summarize the Health Insurance Portability and Accountability Act (HIPAA) and explain characteristics of advanced directives, living wills, durable power of attorney, and other legal directives governing medical treatment. Explain, using domain-specific language and accurate definitions of legal concepts, how the content of these legal documents impacts patients' rights for all aspects of care. (TN Reading 1, 2, 4, 5)

6) Construct an argumentative essay developing a claim about the impact of a specific piece of local, state or federal legislation (such as, but not limited to, bans on smoking, changes to entitlements, etc) on the health of Tennessee. Develop claim(s) and counterclaim(s) fairly, supplying data and evidence for reasoning, including an accurate summary of the legislation. (TN Reading 1, 2; TN Writing 1)

7) Summarize the economic impact of healthcare delivery on the national debt and develop a graph or other visual depicting findings, citing specific textual evidence. (TN Reading 1, 2, 7; TN Writing 4)

8) Calculate the costs of a range of health insurance plans, including deductibles, co-pays, PPO's and HMO's. Compare and contrast these plans with the provisions outlined in the Affordable Care Act. For a selected disease/disorder/injury, predict the total cost (including but not limited to the diagnostics, procedures, and medications involved) under each of these plans for the course of the treatment. (TN Reading 9)

9) Gather data related to a specific health issue in a local community (for example, dental health, mental/social health, and chronic health). Identify all healthcare professionals practicing in that community aligned to that specific health issue. Justify the need for an increase or decrease in the number of practicing healthcare professionals based on current data. (TN Writing 1, 7, 9)

Body Function and Structure

10) Outline the gross normal structure and function of all body systems, and summarize appropriate medical text(s) in order to list signs and symptoms of common diseases and disorders associated with each. (TN Reading 2; TN A&P 2, 3, 4, 5, 6)
    a. Integumentary and lymphatic systems
    b. Nervous and musculoskeletal systems
    c. Cardiovascular and respiratory systems
    d. Digestive and urinary systems
    e. Reproductive and endocrine system

Infection Control/Medical Microbiology

11) Demonstrate concepts and skills of asepsis, Universal Precautions, sanitation, disinfection, and sterilization for patient/client care settings in adherence to standards and guidelines from the Center for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA) in a lab/clinical setting. (TN Reading 3)

12) Define the term normal flora and explain how its deviation can prevent or cause a disease or disorder. Outline specific preventive measures to align to acceptable standards of care in the healthcare field. (TN Reading 4; TN Writing 4; TN A&P 5)

13) Compare and contrast healthcare-associated infections with non-healthcare-associated infections, citing relevant surveillance statistics, preventive measures, and methodologies concerning outbreak detection, management and education. (TN Reading 1; TN Writing 7)

Health Records

14) Research the documentation requirements and styles for at least two therapeutic careers. Demonstrate application of proper documentation techniques for a given patient assessment in each of the identified careers. (TN Reading 3; TN Writing 4, 7)

15) Define the terms Health Informatics, Health Information Technology, and Heath Information Management. Compare and contrast the features and purposes of each in different healthcare settings (such as a physician's office, hospital, or emergency services site). (TN Reading 5)

16) Summarize information found in news media, professional journals, and trade magazines to examine how Telehealth has impacted the healthcare system and explain its benefits and challenges. (TN Reading 2)

Patient/Client Interaction

17) Evaluate factors that contribute to effective patient/client communication, demonstrating sensitivity to barriers, cultural differences, and special needs individuals. Use role-plays to demonstrate effective practices within a clinical or classroom setting. (TN Reading 3)

18) Accurately define and demonstrate an understanding of basic medical terminology in order to monitor patient/client status through assessment of:
    a. History and Physical (H&P) include but not limited to: family, environmental, social and mental history.
    b. Head-to-toe assessment
    c. Vital Signs assessment (VS)
    d. Height/weight, BMI calculation
    e. Dietary assessment
    f. Dental Assessment
    g. Visual examination
    h. Evaluation of diagnostic test results
    (TN Reading 4, 5; TN A&P 1)

19) Develop a detailed treatment plan, incorporating accurate medical language, for a case study patient using applicable assessment information following an interview with patient or family member. (TN Reading 3, 4; TN Writing 4)

20) Develop a patient health education plan including preventive measures, signs and symptoms of exacerbation of disease/disorder/injury, pharmacological needs, and support systems. Include citations from at least three medical texts. (TN Reading 1, 3; TN Writing 2, 4, 7, 9)

21) Monitor, evaluate, reassess and report significant changes in a patient/client's physical, social, or mental status and relate findings to normal and abnormal anatomy and physiology using either a case study or family member. (TN Reading 9; TN Writing 9)

22) Construct a chart or graph to identify and document all healthcare professionals involved in the assessment, monitoring, treatment, and rehabilitation (if applicable) for the patient/client used in previous standards. (TN Writing 4)

Therapeutic Statistics

23) Synthesize charts, statistics, and other health-related data to understand the distribution and determinants of disease in target populations as related to therapeutic services (such as heart disease in women), and communicate this knowledge to the public through role-plays, written materials, or other informational resources to improve the health of the community. (TN Reading 2, 7; TN Writing 4, 7, 8, 9)

24) Evaluate research related to diseases, statistical information, and epidemiology to determine the unique needs of a target population as related to therapeutic services (such as cardiovascular rehabilitation services). Compare the incidence of a particular disease/disorder within this population to its prevalence on local, state, regional, and national levels. (TN Reading 2, 9)

25) Investigate the research and development of pharmaceutical agents, trends related to biotechnology and pharmaceuticals, immunizations, and pharmacogenomics. Conduct a long-term independent research project to craft an explanatory text narrating scientific procedures or technical processes (such as DNA-specific medications). Cite evidence from articles in scientific journals, defining the questions the author seeks to address. (TN Reading 1, 2, 6; TN Writing 2, 7, 8, 9)

Community Health

26) Successfully perform American Red Cross or American Heart Association adult, child, and infant Basic Life Support (BLS) cardiopulmonary resuscitation (CPR) for Healthcare Providers and First Aid skills. (TN Reading 3)

27) Research a local community emergency response team. Investigate therapeutic careers involved with emergency response; describe the education and training required for these healthcare professionals. (TN Reading 2)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- TN A&P: Tennessee Science: Anatomy and Physiology
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Nursing Education

Primary Career Cluster:	Nursing Education
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6000
Prerequisite(s):	*Medical Therapeutics* (5999) and *Anatomy & Physiology* (5991) (pre- or co-requisite)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the final course in *Therapeutic Nursing Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Students enrolled in this course who wish to pursue certification must spend a minimum of 40 hours in a clinical setting. Twenty-four of the 40 hours must be spent in a long-term care facility, and the remainder can take place in any setting that employs certified nursing assistants. Teachers must hold an active WBL Certificate provided by the Tennessee Department of Education. For more information, please visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Certified Nursing Assistant
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	This course can only be taught by Registered Nurses.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Nursing Education is a capstone course designed to prepare students to pursue careers in the field of nursing. Upon completion of this course, a proficient student will be able to implement communication and interpersonal skills, maintain residents' rights and independence, provide care safely, prevent

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emergency situations, prevent infection through infection control, and perform the skills required of a nursing assistant. At the conclusion of this course, if students have logged 40 hours of classroom instruction and 20 hours of classroom clinical instruction, and if they have completed 40 hours of site-based clinical with at least 24 of those hours spent in a long-term care facility, then they are eligible to take the certification examination as a Certified Nursing Assistant (CNA).

Prior to beginning work at a clinical site, students must be certified in Basic Life Support (BLS) Cardiopulmonary Resuscitation (CPR), and deemed competent in basic first aid, body mechanics, Standard Precaution guidelines, and confidentiality. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Anatomy & Physiology, and Tennessee Nursing Education Training Program requirements.*~~

Note: In order for students to qualify for the nursing assistant certification examination, the training program must be approved at least 30 days before the first day of class by the Tennessee Department of Health Nurse Aide Training program staff.

Work-Based Learning Framework

Clinical experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. The TDOE provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities. Additionally, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning.

Program of Study Application

This is the capstone course in the *Therapeutic Nursing Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Professionalism, Residents' Rights, and Independence

1) Differentiate between the services and careers in a long-term care (LTC) setting. Document allowable length of stay, payment options, and regulation of LTC facilities in written, oral, and digital artifacts. Research and document educational requirements as well as state and national guidelines governing practicing professionals (such as licensing, certifications, training, and compliance) in a long-term care (LTC) setting. ~~(TN Reading 2; Writing 2, 7, 8, 9)~~

2) Identify personal and professional characteristics of an employee in an LTC facility. Explain the characteristics in the context of the nursing assistant's role and relate them to common professionalism expectations, including expectations surrounding attire, accountability including chain of command, scope of practice, resident care plan, nursing process, productivity and time management, performing duties as assigned, and demonstrating ethical behavior. Set goals for

demonstrating these skills and document progress through a Personalized Learning Plan, addressing key employability skills relating to career knowledge and navigation skills, 21st century learning and innovation skills, and personal social skills. (TN Reading 2, 4; TN Writing 9)

3) Obtain a copy of an LTC facility residents' right document. Analyze the document and discuss in a written, oral, or digital artifact** the importance of maintaining a healthy, safe, and respectful environment that includes families and friends. Address at minimum the following components: residents' environment and quality of life; obligation of staff to inform resident and their families of rights and services; right to participate in own care; right to independent choice; informed consent; right to privacy and confidentiality; maintaining care and security of residents' personal possessions; and avenues for dealing with disputes and/or grievances. (TN Reading 1, 2, 5; TN Writing 2, 4, 6, 8, 9)

4) Interpret the Omnibus Reconciliation Act (OBRA) and explain the key concepts in an informational artifact that can be used when teaching new residents and/or their families. Key concepts can include, but are not limited to:
    a. Importance of an individualized plan of care for each resident
    b. Minimal requirements for nursing assistant training
    c. Long Term Care Minimum Data Sets (MDS) guidelines
    d. Roles of Ombudsmen
    e. Explanation of Long-Term Care Minimum Data Set
    f. Purpose and importance of Patient Self-Determination Act
   (TN Reading 1, 2, 4; TN Writing 2, 4, 8, 9)

5) Summarize the Health Insurance Portability and Accountability Act (HIPAA). Create a digital or written artifact that differentiates between the characteristics and rights of residents pertaining to advanced directives, living wills, durable power of attorney, and other legal directives governing medical treatment in a long-term care setting. Explain, using domain-specific language and accurate definitions of legal concepts, how the content of these legal documents influences residents' rights in a long-term care facility for all aspects of care. (TN Reading 1, 2, 4, 5; TN Writing 4, 6, 8, 9)

6) Define the terms *abuse* and *neglect*, and differentiate among various types of abuse and neglect through an evaluation of scenarios. Document findings from the scenarios, including all suspicious findings and actual signs of abuse and/or neglect. Accurately summarize the findings, citing evidence from documentation. (TN Reading 1, 2, 4, 7; TN Writing 4, 6, 8, 9)

7) Review LTC facility policy and procedures pertaining to use of physical and mental restraints of residents. Drawing on evidence from health journals and patient rights advocacy organizations, develop an informational artifact discussing the types of restraints, reasons for their uses, restraint alternatives, any associated physical and psychological problems, and residents' rights associated with restraints. The artifact should be assembled in a print or digital format that could be shared with a resident, his/her family, and/or co-workers, citing specific textual evidence and incorporating evidenced-based practice. (TN Reading 1, 4; TN Writing 5, 6, 8, 9)

Communication/Cultural Diversity

8) Examine the skills needed to effectively and respectfully communicate with an LTC resident. Discuss such facets as verbal and nonverbal communication, how to respond to residents' negative or changing behaviors, cultural diversity, residents with special needs or cognitive impairments, barriers to communication, and integration of assistant's interpersonal skills. Practice communication skills, professional and ethical behavior, and non-discrimination standards in a classroom clinical and LTC setting with classmates, families, geriatrics, and persons with special needs, obtaining objective and subjective patient information. (TN Reading 2, 3, 4, 9; TN Writing 8, 9)

9) Research guidelines and formats pertaining to nursing assistant documentation in an LTC facility. Interpret domain-specific words and phrases that are used in documentation, especially in regards to legal requirements and correct medical terminology. Role-play giving and receiving a resident status report using the documented information. (TN Reading 3, 4, 9; TN Writing 4, 5, 6)

Infection Control/Medical Microbiology

10) Review infection control guidelines, Standard Precaution guidelines, Transmission-Based precautions, Personal Protective Equipment use, and infection control of elderly in an LTC facility. Practice skills related to hand washing, donning and doffing a gown, masks, gloves and goggles, handling and cleaning spills, cleaning equipment, and handling laundry. (TN Reading 1, 2, 3, 4)

11) In a written or digital format, synthesize information from a range of sources, such as the Centers for Disease Control, into a coherent understanding of the signs/symptoms (s/sx), causative agents, and precautions and preventive measures for the following infectious diseases frequently encountered in an LTC:
   a. Tuberculosis
   b. Hepatitis
   c. Methicillin-resistant Staphylococcus aureus (MRSA)
   d. Vancomycin-Resistant enterococcus (VRE)
   e. Clostridium difficile or C. diff
   f. Nosocomial infections
   (TN Reading 1, 2, 7, 9; TN Writing 2, 7, 8, 9)

Safety/Emergency Care

12) Develop a health education presentation, public service announcement, or brochure for healthcare professionals in an LTC facility aimed at identifying persons at greatest risk for accidents. Include at least the following: types of risk, how to identify risk, signs and symptoms of physical complications of risk, guidelines for preventing risk, and residents' rights. Include at least three resources. (TN Reading 1, 3, 5; TN Writing 2, 4, 7, 9)

13) Investigate the principles of proper body mechanics for the LTC staff members and for the residents. Document industry-specific guidelines for assisting the resident and/or family member to group and other activities safely. Apply the principles in a classroom clinical setting in order to prevent injury and utilize less energy. (TN Reading 1, 3, 9; TN Writing 9)

14) Outline potential medical emergencies within an LTC facility, especially those related to fire, oxygen, choking, wandering or sundowner's syndrome, shock, Myocardial Infarction (MI), bleeding, burns, fainting, diabetes, Cardiovascular Accident (CVA), and natural disasters. Generate a plan and/or guidelines of care for each of the areas previously listed, incorporating facility policies, national standards, and any other resource necessary. (TN Reading 2, 3, 7, 9; TN Writing 2, 6, 8, 9)

Basic Nursing Skills

15) Outline the normal structure and function of body systems related specifically to geriatric clientele, and summarize appropriate medical text(s) in order to list signs and symptoms of common diseases and disorders associated with each. Compile a paper or digital artifact describing abnormalities in geriatric patients and what should be reported to a nurse and/or physician for the following:
    a. Integumentary systems
    b. Nervous system with eye and ears
    c. Musculoskeletal systems
    d. Cardiovascular and respiratory systems
    e. Digestive and urinary systems
    f. Endocrine systems
    (TN Reading 2; TN A&P 2, 3, 4, 5, 6)

16) Assess vital signs to determine oral temperature, radial and apical pulse, respirations, blood pressure, height, and weight. Calculate body mass index (BMI). Identify acceptable ranges for adult and geriatric patients, as well as the measurements that must be reported to the nurse, including possible causes. Document assessment finding on a classmate or resident's chart at least ten times during the semester. (TN Reading 2, 3, 8; TN Writing 9)

17) In a role-play scenario, articulate nursing assistant standards for the care of a resident who is receiving oxygen therapy. Be able to discuss the reasons for oxygen therapy, types of therapy, types of devices, and safety precautions. Document the process using clear, concise writing skills and domain-specific medical terminology. (TN Reading 3, 8; TN Writing 4, 9)

18) Conduct a short research project to evaluate the causes and management of physical pain in LTC and geriatric residents. Synthesize the information from multiple authoritative sources in a written, creative, or digital presentation (such as a science fair presentation or an art therapy presentation). (TN Reading 3, 8, 9; TN Writing 2, 4, 7, 8, 9)

Personal Care Skills

19) Understand principles of and successfully perform skills related to personal care. Incorporate guidelines for residents' rights and utilize rubrics from textbooks, National HOSA guidelines, or other clinical standards of practice for the following:
    a. Principles of self-care versus full care
    b. Bathing/skin care/back rub
    c. Grooming/shaving/hair care/nail care
    d. Mouth care/denture care of conscious and comatose resident
    e. Dressing

f.   Transfers, positioning, turning in bed
   g.   Bed making, occupied and unoccupied
   h.   Care for resident when death is imminent
   (TN Reading 3, 6)

20) Understand principles of and successfully perform skills related to toileting, intake and output, and bedpan or bedside commode use. Incorporate guidelines for residents' rights and utilize rubrics from textbooks, National HOSA guidelines, or other clinical standards of practice for the following:
   a.   Urine characteristics, and abnormalities that should be reported to the charge nurse
   b.   Common disorders of bladder and bowels
   c.   Factors affecting elimination of urine or stool
   d.   Types of urine specimens obtained
   e.   Catheter care/emptying urinary bag
   f.   Procedure for collecting urine and stool specimens
   g.   Care guidelines for ostomy
   (TN Reading 3, 6)

21) Understand principles of and successfully perform skills related to proper feeding techniques to assist with eating and hydration. Incorporate guidelines of residents' rights and utilize rubrics from textbooks, National HOSA guidelines, or other clinical standards of practice for the following:
   a.   Nutritional needs of the elderly
   b.   Factors that influence food preference
   c.   Special diets
   d.   Thickened liquids
   e.   Swallowing issues and dysphagia
   f.   Heimlich per American Heart Association or American Red Cross standards
   (TN Reading 3, 6)

22) Understand principles of and successfully perform skills related to basic restorative care. Incorporate guidelines of residents' rights and utilize rubrics from textbooks, National HOSA guidelines, or other clinical standards of practice for the following:
   a.   Promoting self-care
   b.   Range of Motion (ROM) exercises and maintenance
   c.   Ambulation with and without assistive devices
   d.   Use of assistive devices in transferring, eating, and dressing
   e.   Care and use of prosthetic/orthotic devices
   f.   Role of physical therapy, occupational therapy, and speech therapy in LTC and assisted living facilities
   (TN Reading 3, 6)

Mental Health, Social Needs, and Care of the Cognitively Impaired

23) Investigate mental health diseases in the elderly and compare their challenges to those faced by middle adults in Erikson's psychosocial developmental stage. Use technology to produce a health education plan, public service announcement, or a public health presentation intended to inform the public about signs and symptoms, incidence, how the disease/disorder affects the

resident and/or family, how to modify staff behavior in response to residents' behavior, and possible treatments. (TN Reading 1, 2, 7, 9; TN Writing 6, 8, 9)

24) Drawing evidence from professional journals and other evidence-based medical websites, analyze the normal changes that occur in the aging of the elderly brain. Include in the analysis: (a) developmental task of aging, (b) methods to reduce the effects of cognitive impairment, (c) attitudes of staff caring for cognitively impaired residents, (d) communication with cognitively impaired residents, (e) methods to reduce effects of cognitive impairment, and (f) acceptable interventions associated with cognitive disorders and behaviors. Present the information in individual or group work using digital and written formats. (TN Reading 1, 2, 9; TN Writing 2, 4, 6, 8, 9)

25) Examine a range of ethical dilemmas encountered in an LTC facility. For example, compare and contrast the legal rights of residents to make their own personal choices with instances in which family involvement may be necessary in order to care and make decisions for patients who have cognitive disorders. Craft an original argument outlining the circumstances under which a certain behavior or medical decision would be ethically or legally justified, citing examples and medical evidence to support claims. (TN Reading 1, 2, 9; TN Writing 1, 4, 8, 9)

26) Describe therapies or strategies for addressing the unique needs of cognitively impaired residents and modifying behavior in a positive manner. Identify any resources or support groups available in the local community for resident and families. Reach out to those resources and/or groups to obtain information; then develop a written or digital teaching plan for residents and families. (TN Reading 1, 2, 9; TN Writing 2, 4, 6, 8, 9)

Portfolio

27) Compile and continually update a portfolio of artifacts completed in this course. If pursuing Nursing Assistant certification or dual enrollment/dual credit hours, document hours spent on activities such as clinical placement or classroom contact with an articulated institution. Upon completion of the course, prepare the portfolio in a professional style to present to an appropriate nursing audience. (TN Reading 3; TN Writing 5, 9)

The following artifacts will reside in the student portfolio:
- Skills performance rubrics
- Documentation of long-term clinical hours
- Documentation of classroom clinical hours
- Examples of written, oral, or digital presentations
- Job applications
- Resumes
- Mock or actual job interviews

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN A&P: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Science, Human Anatomy and Physiology.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- Nurse Aide Training Program requirements for Tennessee
  - These are the minimum requirements that all programs must include in order for students to be eligible to take the competency evaluation to become a Certified Nursing Assistant.

Additional Notes

**Artifacts can include, but are not limited to, brochures, posters, fact sheets, narratives, essays, and presentations. Graphic illustrations can include, but are not limited to, charts, rubrics, drawings, and models.

Emergency Medical Services

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5995
Prerequisite(s):	*Emergency Preparedness* (6151)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the fourth course in *Emergency Services* and *Fire Management Services* programs of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Emergency Medical Responder (EMR), if teacher is an authorized EMS Instructor at the EMR level for EMR 60 hours of instruction; if not authorized, then the program must have an authorized instructor to coordinate with the local office of EMS and provide required training.*
Dual Credit or Dual Enrollment Opportunities:	There are dual credit/dual enrollment opportunities available for this course. Reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720, 751
Required Teacher Certifications/Training:	If teachers are teaching this course as First Responder certification, then they must have 8 hours of training provided by Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

*National Emergency Medical Services Educational Standards should be incorporated into instruction.

Course Description

Emergency Medical Services is a capstone course designed to prepare students to pursue careers in the fields of emergency medicine. Upon completion of this course, proficient students will be able to:

Approved January 30, 2015; Amended April 15, 2016

identify careers and features of the EMS system; define the importance of workforce safety and wellness; maintain legal and ethical guidelines; correlate anatomy and physiology concepts to the patient with a medical or traumatic injury; and perform EMS skills with a high level of proficiency. If taught with an EMT instructor, students will be given the opportunity to sit for the National Emergency Medical Responder certification. In addition, students will continue to add artifacts to a portfolio, which they will continue to build throughout the program of study. ~~Standards in this course are aligned with National Highway Traffic Safety Administration, National Emergency Medical Services Education Standards, and Tennessee State Standards in English Language Arts & Literacy in Technical Subjects.**~~

Each standard presumes that the expected knowledge and behaviors are within the scope of practice for that EMS licensure level, as defined by the National EMS Scope of Practice Model. Each competency applies to patients of all ages, unless a specific age group is identified. The standards also presume there is a progression in practice from the Emergency Medical Responder level to the Paramedic level. The descriptors used to illustrate the increasing complexity of knowledge and behaviors through the progression of licensure levels originate, in part, from the National EMS Scope of Practice Model.

Note: If this course is taught for EMR certification, the program must be approved by the TN Department of Health, Office of Emergency Medical Services. **Students enrolled in this course must be 17 years old before the course concludes.**

Program of Study Application

This is the capstone course in the *Emergency Services* and the *Fire Management Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science or the Law, Public Safety, Corrections and Security website at http://www.tn.gov/education/cte/LawPublicSafetyCorrectionsSecurity.shtml.

Course Standards

EMS Systems and Operations

1) Compare and contrast the types of Emergency Medical Services (EMS) systems and operations, including ground, water, and air services. For each type of service, discuss how the public accesses EMS systems, the advantages and disadvantages, special considerations, and safety issues. Discuss the roles played by the state departments of EMS and the National Highway Traffic Safety Administration. ~~(TN Reading 2, 4, 9; TN Writing 8; EMR-P, EMR-EM)~~

2) Research the history of mapping, geographic information systems (GIS), global positioning systems (GPS), remote sensing, and other geospatial technologies. Examine how these technologies have evolved in the area of EMS, concentrating on their recent migration towards online platforms, and evaluate their influence on present-day society, citing specific textual evidence from news articles and scholarly journals. ~~(TN Reading 1, 2; TN Writing 2, 7)~~

3) Differentiate between the careers in various types of EMS. Research and document educational requirements as well as state and national guidelines governing practicing professionals (such as licensing, initial certifications, re-certifications, training, and compliance). Identify personal and

physical characteristics required of an EMS professional in a career portfolio. (TN Reading 1, 2, 9; TN Writing 2, 7, 8, 9; EMR-P)

4) Using texts from EMS professional journals or websites, evaluate concepts of quality improvement to provide safe, high quality, and appropriate patient care and the impact of research on EMR care. Cite examples of research that have been incorporated into improving emergency care for patients and/or victims of accidents/injuries. (TN Reading 1, 2, 7, 9; TN Writing 2, 4, 8, 9; EMR-P, EMR-MT)

5) Outline the risks and responsibilities facing the emergency response team during ambulance operations. Address at minimum the following: apparatus and equipment readiness; pre-arrival considerations, especially for high-risk situations; scene safety of personnel and patient(s); traffic; 360 degree assessments; and how to leave a scene. (TN Reading 2, 3, 9; TN Writing 9; EMR-EM)

6) Review guidelines from the *Emergency Preparedness* course related to National Incident Management System (NIMS) compliance (at minimum, IS-700, IS-800, ICS-100), and provide support for the inclusion of such concepts in the EMS system. Develop a plan for handling multiple casualty incidents, including hazardous waste, Simple Triage and Rapid Treatment (START) Principles, resource management, and care of EMS personnel on-site. (TN Reading 1, 2, 3, 4, 9; TN Writing 4, 7, 8, 9; EMR-EM, EMR-PH)

7) Research and summarize the concepts surrounding vehicle extrication, including safe vehicle extrication, tools used, and patient considerations. Include in the summary common guidelines related to the following: roles of EMS; safety of staff, patients, and situation; vehicle stabilization; unique hazards; additional resources needed; and extrication considerations. (TN Reading 2, 3, 4; TN Writing 4, 9; EMR-EM)

Safety and Wellness

8) Develop a reference toolkit of physical, mental, and personal requirements for personnel in emergency and public safety services. Document what the "profile of proficiency" looks like for professionals in these fields—for example, what scores are needed on a physical, mental, or emotional fitness test, and what guidelines must be followed for personal disease/disorder control. (TN Reading 2, 9; TN Writing 2, 4, 6, 8, 9; EMR-P, EM-PH)

9) Investigate stress management procedures for professionals in the emergency response and public service sectors. Identify stressors and stress-inducing situations through interviews with professionals in the field. Collaborate with a team to identify techniques and strategies for managing and alleviating stress. Communicate recommendations in the form of a toolkit, brochure, or fact sheet to support the use of these strategies, citing evidence drawn from the investigation. (TN Reading 1, 2, 9; TN Writing 4, 6; EMR-P)

10) Compare and contrast in a digital or written artifact the difference in Standard Precautions, personal protective clothing, and personal protective equipment (PPE) in EMS from other healthcare settings. Outline response steps if exposed to hazardous or bloodborne pathogens. Demonstrate donning and doffing of all PPE and the care of soiled equipment or vehicles. (TN Reading 2, 3, 4; TN Writing 6, 9; EMR-P, EMR-PH)

11) Interpret scene management and safety standards and/or protocols by writing a scenario for each of the following situations: (a) traffic or highway incidents, (b) violent encounters, (c) crowds, (d) nature of illness or mechanisms of injury, (e) number of patients and/or victims, and (f) personnel injury prevention. Identify the appropriate responses from EMS professionals and any additional resources that would be involved. (TN Reading 1, 2, 3, 9; TN Writing 2, 9; EMR-P, EMR-EM)

12) Review National Incident Management System (NIMS) compliance courses from the *Emergency Preparedness* course, IS-700, IS-800, and ICS 100, in addition to completion of ICS 200 (Single Resources and Initial Action Incidents) and IS-5A (Introduction to Hazardous Materials). Role play scenarios that involve each of these situations and identify roles and responsibilities of the EMR and other team members. (TN Reading 2, 9, FEMA NIMS)

EMS and Therapeutic Communications

13) Identify situations and locate agencies an Emergency Medical Responder (EMR) would call for additional assistance upon arrival at a scene. Practice scenarios that would require the transfer of care of the patient, incorporating pertinent information such as the patient's condition, history of what happened, care given, etc. (TN Reading 3, 4, 9; TN Writing 9; EMR-P, EMR-MT)

14) Review the concepts of effective therapeutic communication. Examine interview techniques used during therapeutic communication and identify potential hazards of interviewing. (TN Reading 3, 9; EMR-P, EMT-LD)

Legal/Ethical Guidelines

15) Interpret the rules, guidelines, and legal ramifications related to incident documentation by EMS staff. Complete a pre-hospital care report utilizing appropriate medical terminology and the acronyms SAMPLE, DCAP-BTLS, and OPQRST. (TN Reading 3, 4, 5; TN Writing 4, 6, 8, 9; EMR-P, EMR-MT)

16) Summarize the Health Insurance Portability and Accountability Act (HIPAA). Explain characteristics of consent, confidentiality, advanced directives, living wills, durable power of attorney, and other legal directives governing medical treatment. Using domain-specific language and accurate definitions of legal concepts, explain how the content of these legal documents impacts patients' rights for all aspects of care. (TN Reading 1, 2, 4, 5, 6; EMR-P, EMR-MT)

17) Examine real-world situations that involve ethical dilemmas and the application of correct professional conduct as highlighted in recent news articles. Craft an argumentative essay making a claim about the importance of ethics and professional standards for persons working in Emergency Medical Services occupations. Cite examples from case studies to argue for the relevance of professional codes of conduct within scope of practice and how important it is to follow those guidelines. (TN Reading 2, 9; TN Writing 1, 4, 9; EMR-P, EMR-MT)

18) Research legal ramifications and responsibilities of the EMR associated with evidence preservation and mandatory reporting requirements within the EMS system. Identify the

process for reporting specific situations to the appropriate authorities, such as child abuse and/or crimes. (TN Reading 2, 9; TN Writing 4, 9; EMR-P, EMR-MT)

Anatomy/Physiology/Pathophysiology

19) Outline the gross and cellular anatomy and physiology of the musculoskeletal, respiratory, and cardiovascular systems. Discuss acceptable levels of development, vital signs, and psychological norms for all ages, including pediatric and geriatric patients. Review the gross anatomy of the other systems studied in previous courses. (TN Reading 2; TN Writing 8, 9; TN A&P 1, 2, 3, 4; EMR-AP, EMR-PT, EMR-LD, EMT-MT)

Patient Assessment/Evaluation and Treatment

20) Accurately perform the components of patient assessment to identify and manage immediate life threatening illnesses and injuries within the scope of practice of the EMR for pediatric, adult, and geriatric patients, utilizing rubrics from textbooks, National HOSA guidelines, or clinical standards of practice. Include the following areas:
    a. Scene Size-up
    b. Primary Survey or Assessment
    c. History Taking
    d. Secondary Assessment
    e. Reassessment
    (TN Reading 3, 4; EMR-A, EMR-MT, EMR-SP)

21) Identify and perform skills to manage life threatening illnesses based on assessment findings of a pediatric, adult, and geriatric patient with medical emergencies, utilizing rubrics from textbooks, National HOSA guidelines, or clinical standards of practice in the following areas:
    a. Altered mental status
    b. Seizures
    c. Stroke
    d. Gastrointestinal bleeding
    e. Anaphylaxis
    f. Infectious diseases
    g. Diabetes
    h. Psychological emergencies
    i. Chest pain
    j. Poisoning
    k. Respiratory distress/Asthma
    l. Vaginal bleeding
    m. Nosebleeds
    (TN Reading 3, 4; EMR-M, EMR-A, EMR-AW, EMR-AP, EMR-Phar, EMR-S, EMR-SP)

22) Use assessment information to recognize shock, respiratory failure or arrest, and cardiac arrest based on assessment findings. Demonstrate the ability to manage the situation while awaiting additional emergency response. (TN Reading 4, 9; TN Writing 4; EMR-S,EMR-AW, EMR-AP, EMR-PT)

23) Successfully perform American Red Cross or American Heart Association adult, child, and infant Basic Life Support (BLS) cardiopulmonary resuscitation (CPR) for Healthcare Providers or BLS for PreHospital Providers. (TN Reading 3, 4; EMR-M, EMR-T, EMR-AP, EMR-MT, EMR-S)EMR-SP)

24) Research and evaluate National Trauma Triage Protocol. Identify and perform skills to manage life threatening injuries based on assessment findings of a patient with trauma emergencies, utilizing rubrics from textbooks, National HOSA guidelines, or clinical standards of practice in the following areas:
   a. Internal and external bleeding
   b. Chest trauma such as sucking chest wound and impaled objects in chest
   c. Abdominal trauma such eviscerations and impaled objects
   d. Orthopedic trauma such as fractures, dislocations, amputations
   e. Soft tissue trauma, burns, dressings, and bandages
   f. Head, facial, neck and spine trauma such as head injuries, scalp injuries, and injuries to spine
   g. Environmental emergencies such as submersion and exposure to heat and cold
   h. Multi-system trauma
   (TN Reading 3, 4; EMR-T, EMR-MT, EMR-S, EMR-AP, AMR-PT, EMR-SP)

25) Recognize and manage life threats based on simple assessment findings for a patient with special needs while awaiting additional emergency response. Utilize rubrics from textbooks, National HOSA guidelines, or clinical standards of practice for the following special patient populations and situations:
   a. Vaginal bleeding in pregnant patients
   b. Signs of labor and delivery
   c. Steps if EMR needs to deliver
   d. Initial care of neonates
   e. Care of mother after delivery
   f. Pediatric respiratory distress, seizures, and Sudden Infant Death Syndrome (SIDS)
   g. Geriatric care
   h. Child, elderly, and domestic partner abuse
   (TN Reading 3, 4; EMR-SP, EMR-AP, EMR-A, EMR-LD, EMR-MT, EMR-S, EMR-M, EMR-T)

Portfolio

26) Compile and continually update a portfolio of artifacts completed in this course. If pursuing EMR certification or dual enrollment/dual credit hours, document hours spent on activities such as job shadowing or classroom contact with an articulated institution. Upon completion of the course, prepare the portfolio in a professional style to present to appropriate EMS audiences. (TN Reading 1, 2, 3, 4, 8, 9; TN Writing 2, 4, 5, 8, 9; EMR-P1, EMR-P)

The following artifacts will reside in the student's portfolio:
- Career Exploration portfolio
- Skills performance rubrics
- Documentation of job shadowing hours
- Classroom contact hours, if applicable
- Examples of written, oral, or digital presentations
- Short research project documents

Standards Alignment Notes

*References to other standards include:
- National Highway Traffic Safety Administration National Emergency Medical Services Education Standards for Emergency Medical Responders (EMR).
  - All standards are aligned to the [National EMS Educational Standards](#) and [EMR Instructional Guidelines](#) and approved by the Tennessee Department of Emergency Medical Services.
  - Key for alignment: P-Preparatory, AP-Anatomy and Physiology, MT-Medical terminology, PT-Pathophysiology, LD- Life Span Development, PH-Public Health, Pharm-Pharmacology, AW-Airway Management, Respirations and Artificial Ventilation, A-Assessment, M-Medicine, S-Shock and Resuscitation, T-Trauma, SP-Special Patient Populations, EM-EMS Operations
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- Federal Emergency Management Agency, [National Incident Management Systems](#) Emergency Management Institute curriculum

Rehabilitation Careers

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5990
Prerequisite(s):	*Health Science Education* (5998)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is a third course choice in the *Therapeutic Clinical Services* program of study and the second course in the *Clinical Exercise Physiology* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visithttps://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Rehabilitation Careers is an applied course designed to prepare students to pursue careers in rehabilitation services. Upon completion of this course, a proficient student will be able to identify careers in rehabilitation services, recognize diseases, disorders or injuries related to rehabilitation services and correlate the related anatomy and physiology then develop a plan of treatment with appropriate modalities. Standards in this course are aligned with Tennessee State Standards for English

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the second course in the *Clinical Exercise Physiology* program of study and the third course in the *Therapeutic Clinical Services* program of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Careers

1) Research careers within the Rehabilitation career pathway in Athletic Training, Physical Therapy, Occupational Therapy, Speech Therapy, Music Therapy, Pet Therapy, Exercise Therapy, Message Therapy, Chiropractic Medicine and Recreation Therapy. Explain in detail the educational/credentialing requirements, professional organizations, and continuing education unit requirements necessary for success in these fields, as well as state and national compliance guidelines required of Rehabilitation professionals. (TN Reading 2, 9; TN Writing 9)

2) Investigate and compare the range of skills, competencies, and professional traits required for careers in the Rehabilitation careers pathway. Using real-time and projected labor market data, identify local and national employment opportunities and determine areas of growth in rehabilitation careers. (TN Reading 2, 7; TN Writing 8, 9)

3) Compare and contrast the specific laws and ethical issues that impact relationships among patients/clients and the healthcare professional, and debate these issues in an oral or written format. Include issues such as codes and standards of practice. (TN Reading 2, 9; TN Writing 1, 4)

4) Summarize the Health Insurance Portability and Accountability Act (HIPAA) and other legal directives regarding medical treatment and analyze their impact on patient rights. Include confidential information shared concerning minor athletes and/or patients with someone other than parents. (TN Reading 1; TN Writing 9)

Healthcare Systems

5) Calculate the costs of a range of health insurance plans, including deductibles, co-pays, PPO's and HMO's. For a selected disease/disorder/injury, predict the total cost (including but not limited to the diagnostics, procedures, and medications involved), allowable reimbursement, and actual reimbursement under each of these plans for the course of the treatment. (TN Reading 7; TN Writing 8, 9)

6) Investigate current issues and practices surrounding assessment and treatment of clients seeking rehabilitation services such as athletes, military personnel, or patients recovering from surgery or trauma. Demonstrate understanding and application of major legislation and policy affecting patient/client interaction by determining the central idea or conclusion of a text.

Construct an argumentative essay explaining the identified issue, any legislation and outcomes. Include both claims and counterclaims equally. (TN Reading 2; TN Writing 1)

7) Gather information on the history and development of physical therapy, occupational therapy, speech therapy, and athletic training, including but not limited to significant changes in the profession, major contributors to the field, and impactful practices that were developed. Document findings from print and digital professional journals, rehabilitation career related websites, and textbooks in an oral, visual, digital, or paper product with proper citations. (TN Reading 1, 2; TN Writing 6, 8)

8) Evaluate factors that contribute to effective patient/client communication, demonstrating sensitivity to barriers, cultural differences, and special needs individuals. Apply effective practices within a lab/clinical setting. (TN Reading 2; TN Writing 9)

Anatomy and Physiology

9) Outline the gross and cellular anatomy and physiology of the musculoskeletal, neurological, and cardiovascular systems. Review the gross anatomy of the other systems studied in previous courses. (TN Reading 2; TN Writing 8, 9; TN A&P 1, 2, 3, 4)

10) Investigate the basic principles of kinesiology and relate in an informational paper, brochure, or presentation the connection to disease/disorder prevention. Address at minimum: movements of joints and bones, planes, directional terms, body motions, motions between joint articular surfaces, mechanisms of joints and biomechanical levers. (TN Reading 1, 4; TN Writing 6, 9; TN A&P 1, 2)

11) Compare and contrast physiological responses of patients of differing ages, current health status, and presence of acute and/or chronic diseases. For example, compare the response of a healthy elderly patient with a fractured femur to an overweight adolescent with the same fracture. Explain how one would differentiate treatment to meet varying conditions. (TN Reading 2, 9; TN Writing 4, 9; TN A&P 1, 2)

12) Describe the physiological and pathological processes of trauma, wound healing, and tissue repair, and evaluate their implications on the development, progression, and implementation of a therapeutic exercise regimen. For example, examine a post-operative cardiac patient undergoing cardiac rehabilitation. (TN Reading 2, 4; TN Writing 9; TN A&P 1, 2, 3, 4)

13) Identify signs and symptoms as well as pathophysiology for the following injuries/diseases/disorders as they are connected to Rehabilitation Careers. Relate who the appropriate professional would be to provide the care:
    a. Acute inflammation related to an injury
    b. Shock
    c. Communicable diseases, such as pertussis or influenza
    d. Adverse reaction to environmental conditions, both heat and cold
    e. Open and closed wounds
    f. Asthma
    g. Neurological disorders such as stroke, dizziness, and/or vestibular disorders
    h. Orthopedic conditions

i. Speech disorders and/or swallowing disorders
    j. Work- or sports-related injuries
    k. Ambulation or gait difficulties
    l. Concussions
    m. Soft Tissue Injuries
    (TN Reading 1, 4; TN Writing 8, 9; TN A&P 1, 2, 3, 4)

Evaluation and Treatment

14) Describe evidence-based techniques and procedures for evaluating common medical conditions, disabilities, and injuries. Discuss at minimum the procedures surrounding inspection/observation, palpation, testing of flexibility, endurance, and strength, special evaluation techniques, and neurological testing. Role-play practicing these skills on a classmate and/or family member, or within in a lab/clinical setting. (TN Reading 1, 4, 9; TN Writing 7, 9)

15) Define the basic components of injury-specific rehabilitation goals, functional progress, and outcomes in a therapeutic exercise regime. Apply these concepts to a specific case; for example, outline standard goals for a patient who is aphasic. (TN Reading 1, 9; TN Writing 8, 9)

16) List and define the goals, indications, contraindications, and various techniques of therapeutic exercise, including both general and specific exercise regimes relative to treatment of soft tissue, bony, neurological disorders/diseases, and post-surgical complications. (TN Reading 1, 8, 9; TN Writing 4, 8, 9)

17) Describe the indications, contraindications, theory, and principles for the incorporation and application of therapeutic exercise equipment and techniques, including but not limited to: continuous passive motion machine, aquatic therapy, manual therapy, adaptive therapeutic techniques, and/or assistive devices and mobilization. (TN Reading 1, 8, 9; TN Writing 4, 8, 9)

18) Describe common surgical techniques and relevant anatomical alterations that may affect the implementation of a therapeutic exercise regime. (TN Reading 2, 9; TN Writing 2, 9)

19) Using appropriate medical language and terminology, interpret objective and subjective data obtained in standard 13 in developing an appropriate therapeutic treatment plan for a given injury, disease, or disorder, including determination of goals and objectives in order to return the patient to maximum level of performance based on level of functional outcomes. (TN Reading 2, 4; TN Writing 2, 9)

Patient Interaction

20) Understand and successfully practice or evaluate the following treatment modalities with identification of appropriate equipment and inclusion of sanitation methods, universal precautions, and proper body mechanics.
    a. Passive and Active Range of Motion exercises
    b. Gait training with assistive devices
    c. Cryotherapy, elevation, and compression
    d. Hydrotherapy
    e. Heat therapy

  f. Electrostimulation (such as e-stim, TENS, or Ultrasound)
  g. Wound care with or without external hemorrhage
  h. Extrication and transport of athletes
  i. Normalization of body temperature in extreme heat or cold environments
(TN Reading 1, 3)

21) Summarize in an informational paper, brochure, or digital presentation the specific symptoms and proper responses to life-threatening events such as shock, brain injury, and spinal cord injury in athletes. (TN Reading 1; TN Writing 1, 4)

22) Adhering to industry standards and using appropriate medical terminology, document the findings from evaluation, treatment plan, and progress in the therapeutic exercise regime related to a disease or disorder examined in standard 20 or 21. (TN Reading 2, 3, 9; TN Writing 2, 8, 9)

Prevention of Injuries

23) Identify the basic concepts of wellness screening in connection to injury prevention. Complete an injury prevention assessment in a lab/clinical setting.(TN Reading 2, 3; TN Writing 7, 9)

24) Explain and demonstrate the effectiveness of taping, wrapping, bracing, and use of other supportive/protective devices in preventing exacerbation of injury, disease, or disorder in a lab/clinical setting. (TN Reading 2, 3 ; TN Writing 7, 9)

25) Develop a patient health education plan for a real or imagined person that describes recommended preventive measures, signs and symptoms of exacerbation of disease/disorder/injury, pharmacological needs, and support systems to ensure safe and speedy recovery. Incorporate and properly cite information from at least three authoritative sources such as textbooks, digital or print healthcare journals, or interviews with related healthcare professionals. Examples of possible topics include effective heat loss and heat illness prevention, work back injury prevention, reaching and maintaining optimal weight, safe and effective physical activity, and use of pet, recreation, or music therapy in autistic children. (TN Reading 2, 4, 5, 9; TN Writing 2, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~
- ~~TN A&P: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Science, Human Anatomy & Physiology.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Dental Science

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6134
Prerequisite(s):	*Medical Therapeutics* (5999)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the third course in the *Therapeutic Clinical Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Dental Science is an applied course in the *Therapeutic Clinical Services* program of study intended to prepare students with an understanding of the roles and responsibilities of the dental health care professional within the application of dental care. Upon completion of this course, proficient students will be able to differentiate the many careers in dentistry, assess, monitor, evaluate, and report on the dental health of patients/clients and relate this information to overall health, apply appropriate dental

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terminology, and perform clinical supportive skills. In addition, students will continue to build a health science career portfolio that will follow them throughout their chosen program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee state standards in Anatomy and Physiology, American Red Cross BLS CPR Guidelines, and American Heart Association BLS Guidelines. *~~

Program of Study Application

This is the third applied course in the *Therapeutic Clinical Services* program of study. For more information on the benefits and requirements of implementing this program in full, visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Careers in Dental Science

1) Gather relevant information from textbooks and online searches concerning the history of dentistry, with emphasis on changes in care and prevention. Develop a visual, oral, and/or written presentation of the information that includes graphs, technology, and supporting evidence. ~~(TN Reading 2, 7; TN Writing 6, 8)~~

2) Research careers within the dental sciences and explain in a graphic illustration or informational artifact** the educational/credentialing requirements, as well as state and national compliance guidelines required of health care professionals. Include other branches of dentistry such as Orthodontics and Forensic Odontology. ~~(TN Writing 2, 7, 8, 9)~~

3) Analyze the range of skills, competencies, and professional traits (such as leadership, time management, and ethical responsibility) required for careers in dental sciences. Using real-time and projected labor market data, identify local and national employment opportunities and determine areas of growth. Complete a job application, resume, and cover letter for one of the jobs located in the search. ~~(TN Reading 2, 7; TN Writing 4, 6, 8, 9)~~

Legalities and Ethical Issues

4) Choose an ethical issue affecting dental health professionals, such as leaving fluoride out of drinking water, the practice of dental tourism, or the affordability of dental care among vulnerable populations like the elderly. Craft arguments focused on the issue, including the development of claim(s) and counterclaim(s) justified with data and evidence. Discuss how this issue will affect or has affected the dental community. ~~(TN Reading 1, 2, 6; TN Writing 1, 4, 9)~~

5) Examine the legal responsibilities of dental professionals when treating patients/clients with diseases or disorders related to infections transmitted sexually or through drug use, domestic violence, neglect, and child abuse. Construct an informational article intended to raise awareness among dental professionals. Incorporate the correct dental terminology. ~~(TN Reading 1, 2; TN Writing 2, 9)~~

6) Compare and contrast the dental care and prevention customs and cultural beliefs of various populations. Examples might include soaking a cotton ball in turpentine for tooth pain relief or

using bleach to whiten teeth. Develop an informative paper intended to reconcile such beliefs with advances in dental science. ~~(TN Reading 1, 2, 9; TN Writing 2, 9)~~

7) Compare and contrast the average cost of private dental insurance plans versus government-issued plans. Analyze the cost for both pediatric and adult patients for treatments such as a routine dental visit, a visit that requires fillings, and a visit that requires tooth extraction. Role-play therapeutic communication utilizing correct dental terminology to explain the cost with a classmate and/or family member. ~~(TN Reading 1, 2, 9; TN Writing 2, 9)~~

Anatomy and Physiology

8) Outline the gross and cellular structure and function of head and neck anatomy, including bones, muscles, sinuses, salivary glands, nerves, and blood vessels. ~~(TN Reading 2; TN A&P 1, 3)~~

9) Choose a research topic related to embryonic development of the head, oral cavity, and teeth. Gather relevant information from print and digital medical and/or dental resources such as the American Journal of Dentistry. Complete a short research project, including editing work after peer-review, culminating in a scientific report that examines the environmental and genetic factors affecting embryonic development, using dental and medical terminology. ~~(TN Reading 1, 5; TN Writing 2, 5, 7, 8; TN A&P 1, 6)~~

10) Formulate a written and digital health education project to inform an audience about the parts and functions of teeth. Include the effects of nutrition on tooth development and continuous good health and dental prevention care. ~~(TN Writing 2, 6; TN A&P 5)~~

11) Determine the meaning of the universal dental numbering system's name; then, number the teeth located in the human dentition on a model or chart. Explain the difference in each of the numbering systems as presented in text by paraphrasing them in simpler yet accurate terms. ~~(TN Reading 2)~~

12) Choose a dental health disease or disorder. Examples might include dental caries in babies who drink juices from a bottle or oral cancer in smokeless tobacco users. Develop a professional report discussing the scope of the disease/disorder, affected and vulnerable populations, local incidence information as compared to state, region, and national data, existing practices that target the disease/disorder, and interventions available. ~~(TN Reading 1, 2, 7, 8 9; TN Writing 2, 8, 9; TN A&P 1, 3, 6)~~

Microbiology, Infection Control, and Disease Prevention

13) Define the terms pathogenic and non-pathogenic microorganisms, and explain how each can cause a disease or disorder. Outline modes of transmission and prevention of the spread of these organisms. ~~(TN Reading 2, 4; TN Writing 4; TN A&P 1)~~

14) Investigate oral manifestations related to pathogenic and non-pathogenic organisms. Develop an informational text to share with other health care professionals that outlines concepts of disinfection, OSHA standards, and use of Personal Protective Equipment (PPE) to prevent spreading of disease to dental staff. ~~(TN Reading 1, 4; TN Writing 2, 9)~~

15) Differentiate among toxic, corrosive, ignitable, and reactive hazardous wastes in dental facilities. Discuss the role of the Material Safety Data Sheets (MSDS) in identifying hazards associated with specific chemicals or chemical compounds by evaluating MSDS information. Develop a chart describing the characteristics of the most common chemicals and compounds found in the dental office. (TN Reading 1, 4; TN Writing 2, 9)

Dental Examinations

16) Understand principles of and successfully perform skills related to Dental Assisting, incorporating rubrics from textbooks or clinical standards of practice for the following:
   a. Operatory preparation for treatment and receiving of the patient
   b. Positioning of the patient and the clinician
   c. Radiographic process and patient/operator protection
   d. Oral prophylaxis
   (TN Reading 3, 4)

17) Identify basic dental office instrumentation and explain the purpose of each item. Role-play a scenario based in a dental office that uses at least five instruments accurately, including patient assessment, procedure for operatory preparation of the patient room, receiving and seating the patient, and providing at least one treatment. (TN Reading 1, 3, 4; TN Writing 4, 8, 9)

18) Develop a patient health education plan including preventive measures, signs and symptoms of exacerbation of disease/disorder/injury, pharmacological needs, and support systems. Cite at least three medical or dental resources. (TN Reading 1; TN Writing 4, 9)

19) Summarize the signs and symptoms of impending or developing dental emergencies, citing environmental, medical, and hygienic factors that may contribute to the condition. Develop an office emergency policy and procedure that outlines the responsibilities and actions of each healthcare worker. (TN Reading 1, 2, 4; TN Writing 4, 9)

20) Complete training in American Heart Association or American Red Cross adult and child Cardiopulmonary Resuscitation (CRP). Students should be certified in either Heartsaver or BLS for Healthcare Provider CPR prior to clinical rotation. (TN Reading 3, 4; TN A&P 3; American Red Cross BLS CPR Guidelines; American Heart Association BLS Guidelines)

Dental Procedures and Specialties

21) Follow medical procedures precisely when performing patient/client skills in a classroom or clinical setting related to the role of the Dental Assistant, including:
   a. Complete health/dental history
   b. Perform vital signs
   c. Coronal polishing
   d. Fluoride treatment
   e. Preparation of restorative materials
   f. Preparing and alginate impression
   g. Cleaning and sterilizing equipment
   h. Patient and/or community education on oral health

        i.   Document findings and procedure in a recognized format for a dental facility using correct dental terminology

~~(TN Reading 3; TN Writing 4)~~

22) Incorporate medical/dental language in the development of a detailed dental treatment plan for a case study or live patient, describing goals and objectives, medications, and/or alternative treatment and coping mechanisms, and incorporating applicable assessment information following interview/assessment of a patient or family member. ~~(TN Reading 9; TN Writing 2, 9)~~

23) Research emerging dental technologies related to dental and oral health, including but not limited to procedures, equipment, and diagnostics tools. Synthesize information into a coherent understanding and develop a written or verbal presentation. Draw evidence from informational text to support research. ~~(TN Reading 9; TN Writing 6, 8, 9)~~

24) Research a dental specialty procedure (such as oral surgery, prosthetic dentistry, or gingivoplasty), then develop a written or verbal explanation of the procedure using correct dental terminology. Include at minimum the purpose of the procedure, average cost, documented benefits and potential side effects, and profile of the dental professional that performs the procedure. ~~(TN Reading 1,2; TN Writing 2, 8, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- ~~TN A&P: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Science, Anatomy and Physiology.~~
- American Red Cross BLS CPR Guidelines. http://www.redcross.org/.
- American Heart Association BLS Guidelines. http://www.heart.org/HEARTORG/#.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Notes

**Informational artifacts include, but are not limited to, brochures, posters, fact sheets, narratives, essays, and presentations. Graphic illustrations include, but are not limited to, charts, graphs, rubrics, drawings, and images.

Pharmacological Sciences

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code:	6133
Prerequisite(s):	*Health Science Education* (5998) and *Chemistry I* (3221) (pre- or co-requisite)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is one of several options available as the third course in the *Therapeutic Clinical Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students who have also completed a *Clinical Internship* can apply to sit for the Pharmacy Technician Certification Board examination immediately after high school graduation.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Pharmacological Sciences is a third-level applied course in the *Therapeutic Clinical Services* program of study intended to prepare students with an understanding of the roles and responsibilities of the healthcare worker in a pharmacy setting. This course equips students with the communication, goal-

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setting, and information-processing skills to be successful in the workplace, in addition to covering key topics in pharmacology, pharmacy law and regulations, sterile and non-sterile compounding, medication safety, quality assurance, and more. Upon completion of this course, proficient students who have also completed a *Clinical Internship* can apply to sit for the Pharmacy Technician Certification Board examination immediately after high school graduation. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee state standards in Anatomy and Physiology.*~~

Program of Study Application

This is the third course in the *Therapeutic Clinical Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Pharmacology for Technicians

1) Receive and screen prescription/medication orders for completeness and authenticity, identifying generic and name brands of pharmaceuticals, strengths/dose, dosage form, physical appearance, route of administration, and duration of drug therapy. Develop an informative brochure explaining the top 200 medications per the criteria previous listed. ~~(TN Reading 4; TN Writing 2, 6; PTCB Knowledge Domain 1.1, 1.4)~~

2) Construct a teaching plan for an elderly community person explaining definitions of various drug interactions (such as drug-disease, drug-drug, drug-dietary supplement, drug-OTC, drug-laboratory, and drug-nutrient). ~~(TN Reading 1, 4, 9; TN Writing 8, 9; PTCB Knowledge Domain 1.3)~~

3) Compare and contrast the principles of pharmaceutical equivalents, generic equivalence, bioequivalence, pharmaceutical alternatives, and therapeutic equivalents as defined by the U.S Food and Drug Administration (FDA). Summarize the criteria for deeming a product therapeutically equivalent. ~~(TN Reading 1, 2, 9; TN Writing 8, 9; PTCB Knowledge Domain 1.2)~~

4) Differentiate between common and severe side effects or adverse effects, allergies, and therapeutic contraindications associated with the top 200 medications as published in pharmaceutical print and online journals. ~~(TN Reading 1, 2, 4, 9; TN Writing 9; PTCB Knowledge Domain 1.5)~~

5) Research the basic chemical properties, physical properties, dosages, and indications of legend for selected over-the-counter (OTC) drugs and herbal and dietary supplements. Illustrate findings in an oral, visual, or digital presentation, citing information obtained from print and online medical sites such as the U.S. National Library of Medicine databases. ~~(TN Reading 1, 2, 4, 9; TN Writing 6, 8, 9; PTCB Knowledge Domain 1.6)~~

Pharmacy Law and Regulations

6) Design an action plan for a pharmacy related to the storage, handling, and disposal of hazardous substances and wastes (e.g., MSDS) with inclusion of procedures for prevention and treatment of hazardous substances exposure (e.g., eyewash, spill kit, MSDS). (TN Reading 2, 4; TN Writing 8, 9; PTCB Knowledge Domain 2.1, 2.2)

7) Evaluate the Drug Enforcement Administration (DEA) rules and regulations surrounding the transfer of controlled substances, verification of a prescriber's DEA number, and documentation requirements for receiving, ordering, returning, loss/theft, and destruction of controlled substances. Investigate the standards of practice of record keeping for repackaged and recalled products and supplies, including the FDA's recall classification. Summarize findings in an oral, written, or digital presentation. (TN Reading 2, 4; TN Writing 4, 6, 7, 8, 9; PTCB Knowledge Domain 2.3, 2.4, 2.5, 2.10, 2.12)

8) Gather data from Tennessee pharmaceutical board rules and regulations documents concerning record keeping, documentation, and record retention of prescriptions (e.g., length of time prescriptions are maintained on file). List the requirements for restricted drug programs and related prescription processing (e.g., for medications such as thalidomide, isotretinoin, and clozapine). (TN Reading 2, 4; TN Writing 8, 9; PTCB Knowledge Domain 2.6, 2.7)

9) Summarize professional standards related to data integrity and security and Health Insurance Portability and Accountability Act (HIPAA) guidelines. Using domain-specific language and accurate definitions of legal concepts, explain how these areas impact patients' rights for all aspects of pharmaceutical care. (TN Reading 1, 2, 4, 5; TN Writing 8, 9; PTCB Knowledge Domain 2.8)

10) In a lab/clinical setting, demonstrate application of concepts and skills of asepsis, Universal Precautions, sanitation, disinfection, and sterilization for pharmacy settings in adherence to standards and guidelines from the Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA). Perform or check for functions such as proper laminar air flow, hand washing, ensuring a clean room or workspace, and cleaning of counting trays, countertops, and equipment. (TN Reading 2, 3, 4, 5; TN Writing 8, 9; PTCB Knowledge Domain 2.11)

11) Research the professional standards and state and federal laws regarding the roles and responsibilities of pharmacists, pharmacy technicians, and other pharmacy employees; describe when a pharmacist should provide consultation for a patient/client. (TN Reading 1, 2; TN Writing 8, 9; PTCB Knowledge Domain 2.9, 2.13, 2.14)

12) Formulate a list of facility, equipment, and supply requirements (e.g., space requirements, prescription file storage, cleanliness, and reference materials) required for a retail pharmacy as compared with a hospital-based pharmacy. (TN Reading 1, 8, 9; TN Writing 6, 8, 9; PTCB Knowledge Domain 2.15)

13) Develop an informative essay based on research of state and federal laws surrounding a pharmacist/pharmacy technician's roles and responsibilities for detecting prescription abuse. List specific legislation passed or currently in development in Tennessee meant to regulate the purchase of certain over-the-counter medications, such as pseudoephedrine. (TN Reading 1, 2, 5, 6, 7, 8; TN Writing 2, 4, 9; PTCB Knowledge Domain 2.14)

Sterile and Non-Sterile Compounding

14) Research and identify infection control standards utilized in a pharmacy compounding department as established by the CDC and OSHA. Demonstrate application of skills in lab/classroom/clinical setting in order to meet the standards identified. (TN Reading 2, 3, 4; TN CCS Writing 9; PTCB Knowledge Domain 3.1)

15) Demonstrate the following skills surrounding compounding:
    a. Handling and disposal requirements (e.g., receptacles, waste streams)
    b. Documentation (e.g., batch preparation, compounding record)**
    c. Determination of product stability (e.g., beyond-use dating, signs of incompatibility)**
    d. Selection and use of equipment and supplies
    e. Sterile compounding processes**
    f. Non-sterile compounding processes
    (TN Reading 3; TN Writing 4; TN Math N-Q; PTCB Knowledge Domain 3.2, 3.3, 3.4, 3.5, 3.6, 3.7)

Medication Safety

16) Outline in a written or digital presentation industry standards surrounding medication safety. Cite information obtained from textbooks, online and print pharmacy journals, and related websites. Include at minimum the following:
    a. Error prevention strategies for data entry (e.g., prescription or medication order to correct patient)
    b. Patient package insert and medication guide requirements (e.g., special directions and precautions)
    c. Issues that require pharmacist intervention (e.g., DUR, ADE, OTC recommendation, therapeutic substitution, misuse, missed dose)
    d. Common safety strategies (e.g., tall man lettering, separating inventory, leading and trailing zeroes, limited use of error-prone abbreviations)
    (TN Reading 1, 2, 7; TN Writing 4, 6, 9; PTCB Knowledge Domain 4.1, 4.2, 4.3, 4.6)

17) Identify strategies for preventing medication errors by distinguishing medications that either look alike or sound alike, such as Ceftin, Cefotan, Cefzil, Rocephin and Cipro. Include strategies related to recognizing high-alert/high-risk medications such as Sporanox for patients who have ventricular dysfunction. (TN Reading 2, 4, 6, 8; TN Writing 8, 9; PTCB Knowledge Domain 4.4, 4.5)

Pharmacy Quality Assurance

18) Interpret quality assurance practices for medication and inventory control systems (e.g., matching National Drug Code (NDC) number, bar code, and data entry) and for infection control

procedures and documentation (e.g., personal protective equipment [PPE], needle recapping). (TN Reading 3, 4; TN Writing 9; PTCB Knowledge Domain 5.1, 5.2)

19) Explain the common assurance measures used to monitor quality in a pharmacy. For example, explain risk management guidelines and regulations (e.g., error prevention strategies), communication channels necessary to ensure appropriate follow-up and problem resolution (e.g., product recalls, shortages), and productivity, efficiency, and customer satisfaction measures. Summarize information gathered from textbooks, retail pharmacy websites, print pharmacy journals, and/or personal interviews of pharmacists or pharmacy technicians. (TN Reading 2, 9; TN Writing 4, 9; PTCB Knowledge Domain 5.3, 5.4, 5.5)

Medication Order Entry and Fill Process

20) Identify all information a pharmacist or pharmacy technician should obtain from the patient/client before filling and dispensing any medication related to intake, interpretation, and data entry.** Information should include at minimum: name of patient/client, date of birth, address, insurance policy, physician's name, and any drug allergies. Practice interviewing skills in a lab/clinical/classroom setting. (TN Reading 3; TN Math N-Q; PTCB Knowledge Domain 6.2)

21) Create either an electronic or paper profile detailing the order entry process** per industry standards for each of the following: a hospital, a free-standing pharmacy, and a retail-based pharmacy. (TN Reading 3, 4; TN Writing 4, 9; TN Math N-Q; PTCB Knowledge Domain 6.1)

22) Calculate correct doses required when given a simulated prescription for a pediatric dose, adult dose, and geriatric dose based on weight (if applicable), length of administration, times per day of administration, and presence of other diseases/disorders.** (TN Reading 3, 7; TN Math N-Q, A-CED; PTCB Knowledge Domain 6.3)

23) Demonstrate the following skills of the prescription fill process:
    a. Select appropriate product
    b. Apply special handling requirements
    c. Measure and prepare product for final check
(TN Reading 3; PTCB Knowledge Domain 6.4)

24) Demonstrate the following skills of prescription labeling requirements :
    a. Auxiliary and warning labels
    b. Expiration date
    c. Patient-specific information
(TN Reading 3; PTCB Knowledge Domain 6.5)

25) Demonstrate the following skills of prescription packaging requirements:
    a. Type of bags
    b. Syringes
    c. Glass
    d. PVC
    e. Child resistant
    f. Light resistant**
(TN Reading 3; TN Math N-Q; PTCB Knowledge Domain 6.6)

26) Demonstrate the following skills of the dispensing process:
   a. Validation of prescription with pharmacist
   b. Documentation and distribution
   (TN Reading 3; TN Writing 4; PTCB Knowledge Domain 6.7)

Pharmacy Inventory Management

27) Distinguish between the functions and applications of NDC number, lot numbers, and expiration dates of inventory found in a pharmacy. Articulate the importance of this information as it relates to protecting the safety of the public. (TN Reading 2, 4, 7, 8; PTCB Knowledge Domain 7.1)

28) Define the concept of a formulary or approved/preferred product list. Research at least three different insurance companies for a listing of their approved formulary drug list. Compare and contrast the three lists with the top 200 drugs identified earlier in this course. Explain how the phrases "Dispense as Written" or "Do Not Substitute" can affect the formulary. Synthesize research into an informative essay. (TN Reading 1, 2, 4, 8, 9; TN Writing 2, 8, 9; PTCB Knowledge Domain 7.2)

Pharmacy Billing and Reimbursement

29) Role-play explaining the reimbursement policies and plans (e.g., HMOs, PPO, CMS, private plans) to a patient/client who has presented a prescription for three of the top 200 drugs. Ensure the accurate explanation of relevant third-party resolution issues (e.g., prior authorization, rejected claims, plan limitations)** and third-party reimbursement systems (e.g., PBM, medication assistance programs, coupons, and self-pay). (TN Reading 2, 9; TN Writing 4, 9; TN Math N-Q; PTCB Knowledge Domain 8.1, 8.2, 8.3)

30) Compare and contrast healthcare reimbursement systems in home health, long-term care, and home infusion. Develop a technology-enhanced presentation to share information with classmates, healthcare professionals, or pharmacy staff. (TN Reading 6, 9; TN Writing 6, 8, 9; PTCB Knowledge Domain 8.4, 8.5)

Pharmacy Information System Usage and Application

31) Research common software and databases used by pharmacies to manage electronic medical records and prescriptions. Understand the uses and capabilities of these programs as they relate to the roles and responsibilities of the pharmacy technician. (TN Reading 4, 7; PTCB Knowledge Domain 9.1, 9.2)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 1, 3, 5 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and algebraic reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN A&P: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Science, Human Anatomy & Physiology.~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Tennessee Anatomy & Physiology Standard 6 at the conclusion of the course.~~
- PTCB Knowledge Domain: [Pharmacy Technician Certification Exam (PTCE) Blueprint](). The PTCE content was developed nationally by experts in pharmacy technician practice based on a national job analysis study. The updated blueprint is the basis for the PTCE effective November 2013.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning]()
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Additional Standards Notes

**Refers to standards that will require dosage calculations.

Exercise Science

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6170
Prerequisite(s):	*Rehabilitation Careers* (5990)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is the third course in the *Clinical Exercise Physiology* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Exercise Science is an applied course designed to prepare students to pursue careers in kinesiology and exercise physiology services. Upon completion of this course, proficient students will be able to apply concepts of anatomy and physiology, physics, chemistry, bioenergetics, and kinesiology to specific exercise science contexts. Through these connections students will understand the importance that exercise, nutrition, and rehabilitation play in athletes or patients with debilitating or acute metabolic, orthopedic, neurological, psychological, and cardiovascular disorders. In addition, students have the opportunity to incorporate communication, goal setting, and information collection skills in their

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coursework in preparation for future success in the workplace. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee Anatomy and Physiology standards.*~~

Program of Study Application

This is the third course in the *Clinical Exercise Physiology* program of study. For more information on the benefits and requirements of implementing this program in full, please see the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Exercise Science as a Career

1) Define exercise physiology and link to the careers within the Clinical Exercise Physiology career pathway as a cardiac rehabilitation therapist, certified strength and conditioning coach, personal trainer, lifestyle and weight management coach, athletic trainer, and corporate wellness supervisor/instructor. Explain in detail the education level, credentialing/licensure requirements, and continuing education unit requirements necessary for success in these fields, as well as state and national compliance guidelines. Research professional organizations and codes of ethics associated with these occupations. ~~(TN Reading 2, 9; TN Writing 4, 9)~~

2) Compare and contrast the roles and responsibilities of professionals in exercise physiology with those of professionals in other rehabilitation areas. Research and debate in an oral, written, or digital format the differences in client-therapist/trainer relationships, entities of risk management, liability issues, and protocols for working with special populations. ~~(TN Reading 1, 2, 9; TN Writing 1, 8, 9)~~

3) Develop an oral, written, or digital presentation explaining the relationship of exercise physiology professionals with other healthcare and community professionals, especially related to concerns over encroachment and role delineation. Provide suggestions to promote a working, team-building environment. ~~(TN Reading 2, 9; TN Writing 4, 9)~~

4) Design a detailed written or digital artifact explaining the correlation of the sciences of physics, chemistry, biology, anatomy and physiology, bioenergetics, and kinesiology to the emerging science surrounding exercise physiology. Include in the explanation at minimum the following: current research, new technologies and treatments, governmental initiatives, and injury/illness prevention. ~~(TN Reading 1, 2, 4; TN Writing 2, 4, 6, 8, 9)~~

5) Complete a literature review analyzing at least three peer-reviewed articles to answer a research question surrounding the history, development, and future of exercise physiology as a scientific discipline. Document findings in an informational text using appropriate citation conventions, integrating quantitative and graphic information from the articles reviewed. ~~(TN Reading 1, 2, 4, 7; TN Writing 2, 4, 7, 8, 9)~~

Anatomy and Physiology

6) Research the theories of the Specific Adaptation to Imposed Demands (S.A.I.D.) principle and the Frequency, Intensity, Type, and Time (F.I.T.T.) principle. Explain the application of these principles to exercise and fitness, then describe the changes that occur within normal anatomy and physiology associated with these theories. (TN Reading 1, 2, 4, 8, 9; TN Writing 8, 9)

7) Review the *Physical Activity Guidelines Advisory Committee Report* (latest edition) from the U.S. Department of Health. Explain the scientific evidence surrounding participation in regular physical activity and exercise and its association with positive health outcomes, especially involving the cardiovascular, musculoskeletal, and respiratory systems. (TN Reading 1, 2, 4, 6, 7, 9; TN Writing 4, 9)

8) Review the gross and cellular anatomy and physiology of the musculoskeletal, nervous, and cardiovascular systems. Define the terms neuromuscular integration and central command. Summarize how neuromuscular integration, central command, and training and/or rehabilitation plans are based on the integration of the muscle nerve with the muscles of these systems. (TN Reading 2, 9; TN Writing 4, 8, 9)

9) Identify the two types of muscle fibers and their subtypes, slow twitch and fast twitch. Relate the concepts of histochemistry, immunocytochemistry, and physiologic contraction times to the performance of athletes in various sports. Evaluate the role genetics and training play in muscle fiber adaptations. From this research, generate an informational artifact to share with athletes or clients as part of an exercise/training program. (TN Reading 1, 2, 4, 5, 7, 9; TN Writing 2, 4, 8, 9)

10) Review the gross and cellular anatomy and physiology of the respiratory system and explain the ventilation process. Develop an exercise program and a rehabilitation plan for a patient/client who has chronic obstructive pulmonary disease (COPD) and one who is training for a marathon, based on their respective respiratory needs. Compare and contrast these plans to justify the components included. (TN Reading 1, 3, 4, 9; TN Writing 4, 7, 9)

11) Compare and contrast the functions of the cardiovascular system in response to aerobic exercises. Cite the specific changes that are likely to occur and the part of the anatomy that is involved. Using this information, develop a public service announcement, health education/public health presentation, or community awareness brochure to educate local citizens about the importance of exercise in maintaining positive cardiovascular health. (TN Reading 2, 3, 4, 7, 9; TN Writing 4, 6, 8, 9)

Adaptations to Exercise

12) Explain why adaptations must be made to exercise programs to account for different clients' needs. Given a scenario or profile of a client/patient, develop an exercise program with the following adaptations:
    a. Immediate effects of exercise
    b. Long term effects of exercise (heart/lungs/weight control/disease prevention)
    c. Effects of acclimatization (such as changes in temperature, altitude, climate, etc.)
    d. Effects of travel on the client and/or athlete
    e. Medications
    (TN Reading 2, 3, 4; TN Writing 8, 9)

13) Review the concepts of kinesiology and biomechanics from the Rehabilitation Careers course. Explain how joint and bone movement, body motion, and levers can have positive or negative effects on an athlete's performance and development. In a presentation or speech intended for an audience of young athletes, describe the effects of overtraining on the musculoskeletal system, and relate the importance of adopting safe biomechanical practices when training. (TN Reading 1, 2, 4, 9; TN Writing 4, 6, 9)

Nutrition

14) Gather relevant information from multiple authoritative print and digital sources related to the importance of a balanced diet in the achievement of optimum nutrition and exercise. Compare and contrast the nutritional needs of a normal healthy diet with the needs of other clients, such as those training for an intensive sporting event, those with cardiac disease, or those being treated for and/or recovering from illness. Prepare an informative artifact to discuss the findings. (TN Reading 1, 2, 4, 9; TN Writing 2, 8, 9)

15) Investigate the chemical makeup of various sports drinks. In an argumentative essay, debate the nutritional value of these drinks compared to water as a form of hydration, electrolyte replacement, and vitamin replenishment for athletes. State the advantages and disadvantages of each and the dangers that are likely to occur with inappropriate hydration techniques and/or dehydration. Discuss the importance of hydration before, during, and after a sporting event, as well as the factors that affect the hydration process. (TN Reading 1, 2, 9; TN Writing 1, 7, 8, 9)

16) Access a variety of sources, such as professional journals and/or websites, textbooks, and news articles, regarding appropriate nutritional intake recommendations for athletes. Develop a pre- and post-sport activity meal plan for adolescent, young adult, middle age, and older adult athletes in contact and non-contact sports. Include in the meal plan carbohydrate loading, carbohydrate maintenance, protein loading, and nutritional needs for anaerobic versus aerobic exercise. Revise the plan as new information and circumstances arise. (TN Reading 1, 2, 3, 4, 9; TN Writing 4, 5, 8, 9)

17) Cite textual evidence from academic research or nutritional literature to explain how chemical energy contained in glucose, fats, and amino acids is converted to adenosine triphosphate (ATP). In a written, oral, or digital presentation, describe how this process is important in the following areas of practice: health/fitness, medicine, athletic performance, and rehabilitation. (TN Reading 1, 2, 9; TN Writing 4, 6, 9)

18) Choose a health parameter relevant to weight management disorders, such as the presence of anorexia nervosa in teens. Research local incidence information and investigate the scope of the disease/disorder in vulnerable populations. Compare that data to similar state, regional, and national information. Develop an action plan for addressing the weight management disorder for the identified area, complete with an analysis of the pros and cons associated with popular diets, recommended caloric intake, appropriate exercise, and other healthcare interventions. (TN Reading 1, 2, 4, 8, 9; TN Writing 4, 6, 7, 8, 9; TN Math N-Q)

19) According to articles in professional journals, ergogenic aids have been theorized to improve athletic performance in a variety of ways. In an informational essay, state the definition of

ergogenic aids, identify how they are classified (including those that are banned), and describe documented benefits, dangers, and side effects. (TN Reading 1, 2, 9; TN Writing 2, 4, 8, 9)

20) Review the International Olympic Committee's position on banned ergogenic aids and debate the pros and cons of the use of acceptable ergogenic aids, especially related to adolescent athletes. (TN Reading 1, 2, 9; TN Writing 1, 4, 9)

Assessment and Fitness Measurement

21) Understand principles of, and successfully perform skills related to, baseline assessment and fitness measurement, incorporating rubrics from National HOSA guidelines, textbooks, or clinical standards of practice for the following:
   a. Cardiovascular testing
   b. Muscular strength testing
   c. Flexibility testing
   d. Muscular endurance testing
   e. Postural screening
   f. Speed testing
   g. Balance testing
   h. Reaction time testing
   i. Coordination testing
   j. Agility testing
   k. Muscular power testing
   (TN Reading 3, 4)

22) Understand principles of, and successfully perform skills related to, biometric measurements, incorporating rubrics from National HOSA guidelines, textbooks, or clinical standards of practice for the following:
   a. BMI
      i. How to calculate
      ii. Importance of knowing
      iii. Myths and misconceptions
   b. Body fat percentage calculations
   c. Girth
   d. Waist and hip ratio
   e. Resting Heart rate
   f. Resting Blood pressure
   g. Resting Respiratory rate
   (TN Reading 3, 4; TN Writing 9; TN Math N-Q)

Exercise Program

23) Identify and explain the components of an exercise plan. Evaluate an exercise plan for a healthy athlete, then compare and contrast the plan with one that has been designed for a patient with cardiac, neurological, or orthopedic difficulties. Note the similarities and differences in a side by side chart. (TN Reading 4, 8; TN Writing 4)

24) Summarize information from professional journals, websites, and organizations that have developed position papers or reports surrounding the training principles listed below. In the

summary, identify how each principle can be incorporated into the F.I.T.T. principle covered earlier in the course in order to develop an optimal exercise plan for clients who are currently not involved with exercise.
   a. Goal Setting/Reality principle
   b. Inherent Ability principle
   c. Intrinsic Motivation principle
   d. Client Education Model principle
   e. Physical Assessment principle
   f. Overload/Progressive principle
   g. Specificity principle
   h. Trainability principle
   i. Periodization principle
   j. Overtraining principle
   k. Detraining principle
   (TN Reading 1, 2, 4, 6, 9; TN Writing 2, 4, 7, 8, 9)

25) Complete a consultation and evaluation of a patient/client who is preparing for an intense athletic event, recovering from a cardiovascular illness/injury, making lifestyle modifications to improve health, or is required to improve health for work/insurance reasons. Ensure that the evaluation covers therapeutic communication and psychology, nutrition, cardiovascular and muscular strength and endurance, acute variables that will affect training/rehabilitation, and training goals. Document findings in an authentic template using appropriate medical terminology. (TN Reading 2, 3, 4, 8, 9; TN Writing 4, 6, 8, 9)

26) Utilizing information from the consultation, evaluation, fitness testing, and biometric measurements previously obtained, develop and document using appropriate medical terminology an exercise/rehabilitation program for each of the following:
   a. Juvenile athlete
   b. Adult athlete
   c. Senior adult athlete
   d. Cardiovascular rehabilitation
   e. Morbid obese with a co-morbidity
   (TN Reading 2, 4, 7, 8, 9; TN Writing 4, 5, 6, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
- Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

- ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
- ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN A&P: Tennessee Science: Anatomy and Physiology~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Forensic Science

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5996
Prerequisite(s):	*Diagnostic Medicine* (5994)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses.
Programs of Study and Sequence:	This is one of two capstone course options in the *Biotechnology Research* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	Teachers who have never taught Forensic Science MUST attend an 8 hour training provided by Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-health-science

Course Description

Forensic Science is a capstone course designed to draw key connections throughout biology, chemistry, genetics, anatomy, and physics in a setting that supports the criminal justice system. Upon completion of this course, proficient students will have a full understanding of the scope, development, and history of forensic science, the difference between biological and chemical forensics, and how science is used in law enforcement to solve crimes. In addition, students will continue to add artifacts to the portfolio begun in *Health Science Education*, reflecting the full range of activities undertaken in their program of study. Standards in this course are aligned with Tennessee State Standards for English Language Arts &

Approved January 30, 2015; Amended April 15, 2016

Program of Study Application

This is one of the capstone courses in the *Biotechnology Research* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Health Science website at https://tn.gov/education/article/cte-cluster-health-science.

Course Standards

Scope and Development of Forensic Science

1) Define forensic science and explain the connection between science and law enforcement. Summarize the concepts of the eleven sections of forensic science as defined by the American Academy of Forensic Science. List a sample forensic science occupation that falls under each of the eleven sections. (TN Reading 2, 4, 9; TN Writing 8, 9)

2) Develop a career profile for at least three occupations identified from the previous standard, using print, online, and/or personal interview sources to capture at minimum the following:
   a. Job description
   b. Essential knowledge and skills needed for the career
   c. Program or path of study to reach occupational goals, beginning with high school and proceeding through postsecondary
   d. Licensure and credentialing requirements
   e. Non-educational job requirements such as physical fitness tests, minimum age, and psychological evaluations
   f. Role as an expert witness in courts
   g. Specific evidence such professionals are responsible for, such as a forensic nurse assisting with gathering evidence for an alleged rape
   (TN Reading 1, 7; TN Writing 4, 9)

3) Articulate important historical events, contributors, and development of new or changing careers influencing the evolution of forensic science in the United States. Use a timeline or other graphic to illustrate the major developments from the 16th century to today, citing specific textual evidence from textbooks, online and print journals, and other websites. Include major legislation related to the practice of forensic science. (TN Reading 1, 2, 9, 7; TN Writing 2, 9)

4) Citing information found on the American Academy of Forensic Science website, news media, and legislation, describe the evolution of the modern crime laboratory. Discuss the features of present-day crime labs, including the differences between public and private labs. Explore how these features have changed expectations regarding lab services and capabilities, the new or emerging technologies they employ, or the impact on the conviction rates of criminals. (TN Reading 1, 7, 9; TN Writing 4, 7, 8, 9)

5) Research the Crime Scene Investigation (CSI) media phenomenon. Summarize the information from at least three peer-reviewed articles to develop claims and counterclaims about how the

so-called "CSI effect" has impacted forensic science, criminal investigations, and changes in legislation. (TN Reading 2, 9; TN Writing 1)

6) Evaluate the principles of the scientific method and relate their application to forensic science and crime lab procedures. Complete a literature review of at least three peer-reviewed articles concerning current and emerging scientific research in forensic science. Write persuasively on the merits of the research to determine if the methodologies used meet the criteria for rigor outlined in the scientific method. (TN Reading 1, 2, 4, 5, 6, 8; TN Writing 1, 7, 8, 9; TN Scientific Research 2, 3, 4)

7) Research the history of mapping, geographic information systems (GIS), global positioning systems (GPS), remote sensing, and other geospatial technologies. Examine how these technologies have evolved in the field of forensic science, evaluating their influence on present-day society and citing specific textual evidence from textbooks, online and print journals, and other websites. Detail how a range of forensic scientists use GIS technologies in their work. (TN Reading 2, 3, 4, 9; TN Writing 8, 9)

8) Classify examples of forensic evidence into types such as biological, chemical, impressions, and electronic evidence. From this list, generate an explanation of the analysis methods used for physical evidence, such as chromatography, gel electrophoresis, and/or serological analysis. Focusing on one piece of evidence, determine the correct analysis method, explain what kind of information the analysis will yield, and report on how the expected outcomes will contribute to an investigation. (TN Reading 4, 8; TN Writing 7, 8, 9; TN Scientific Research 3, 4, 5)

9) Define chain of custody, starting at the crime scene with collection of evidence until it arrives in a lab. Predict the legal ramifications if chain of custody is not maintained when handling evidence brought to a forensic lab. Explain any special circumstances in which it is appropriate and allowable for physical evidence to be released or destroyed. (TN Reading 2, 9; TN Writing 4)

Biological Forensics

10) Examine the differences in standard precautions, personal protective clothing, and personal protective equipment (PPE) in forensic labs as compared with other healthcare settings. Outline the steps one should take if exposure to hazardous or bloodborne pathogens occurs. Demonstrate donning and doffing all PPE and care of soiled equipment or vehicles. (TN Reading 2, 3, 4; TN Writing 9)

11) Differentiate between the careers of forensic anthropology and forensic odontology by reviewing case studies or viewing simulated remains in a laboratory setting. Explain the scientific processes involved in identifying remains to determine if they are human or nonhuman, and what occurs during a skeletal comparison to determine sex, ancestry, and age. Evaluate dental records or x-rays and identify normal and abnormal dental findings. Document findings from both evaluations using industry-acceptable terminology. (TN Reading 1, 2, 8; TN Writing 4; TN A&P 2)

12) Document a biological profile of remains. Note skin coloration, types of skeletal trauma, presence of defensive wounds or other visible marks, stage of decomposition, entomological activity, environmental factors, rigor mortis, and post-mortem lividity. Include results that could

be gathered by a forensic pathologist, forensic anthropologist, forensic radiologist, forensic dentist, coroner, or law enforcement. (TN Reading 4, 8; TN Writing 2, 4, 7, 8, 9; TN A&P 2, TN Biology II 2)

13) Interpret the findings of an autopsy report found from public records or online resources. Summarize the components that are typically included in an autopsy report; then relate findings to normal anatomy and physiology of the system involved. Describe the responsibilities of a medical examiner in the development of an autopsy, and report on how recent court cases have been influenced by official autopsy reports. (TN Reading 1, 2, 4; TN Writing 4, 7, 9; TN A&P 1, 2, 4)

14) Perform analysis on samples of hair to identify the normal morphology. Using scientific terminology and citation conventions to reference sources, explain the identification and comparison procedures used in crime labs to determine if a sample is natural human hair, manufactured hair, or animal hair. (TN Reading 3, 4; TN A&P 2)

15) Summarize in a graphic illustration the forensic tests performed on body fluids to determine their type. Include at least the following tests: color test, microcrystalline test, precipitin test, and gel diffusion. Explain the differences in antibodies and antigens, their relationships to blood typing, and immunoassay techniques. Perform blood typing procedures using simulated blood as well as other forensic tests as allowed by available equipment. (TN Reading 4, 9; TN Writing 4, 9; TN A&P 2, 3; TN Chemistry II 3)

16) Explain in a written, digital, or oral presentation basic components and concepts related to DNA. Include a definition of DNA, its chief characteristics and structure, and the features of a double helix. Compare and contrast the methods of DNA analysis, such as polymerase chain reaction (PCR), restriction fragment length polymorphisms (RFLPs), and short tandem repeats (STR). Identify the advantages and disadvantages for each, their specific uses in forensics, as well as any limitations. Practice DNA analysis in a classroom or laboratory setting. (TN Reading 1, 2, 3, 4, 7, 8; TN Writing 4, 9; TN Biology II 4, 5, 6)

17) Debate how DNA testing and the Combined DNA Index System (CODIS) have changed the criminal justice system, citing evidence from professional print or digital journals, case studies, court cases, or interviews with law enforcement or forensic scientists to develop claims and counterclaims. (TN Reading 1, 2, 9; TN Writing 1, 4, 9, TN Biology II 5)

18) Conduct a short research project to analyze fingerprint samples. Provide a synopsis of research findings to explain the following: ridge characteristics, underlying anatomy of fingerprint development, and fingerprint classes based on patterns. Explain how fingerprinting and the Automated Fingerprint Identification System (AFIS) have changed the criminal justice system, citing evidence from professional print or digital journals, case studies, court cases, or interviews with law enforcement or forensic scientists to justify claims. (TN Reading 1, 2, 4, 8, 9; TN Writing 7; TN Scientific Research 2, 3, 4, TN A&P 2)

19) Review case studies or case files to identify physiological and psychological factors related to criminal behavior. Relate normal anatomy and physiology with abnormal findings retrieved from literature. (TN Reading 1, 2, 7; TN Writing 7; TN Scientific Research 4; TN A&P 3)

Chemical Forensics

20) Evaluate case studies or case files related to toxicological incidents. Apply analysis of these texts to explain the laboratory tests performed to identify drugs, alcohol, and other toxicology agents. Describe in lab or classroom the theories and scientific processes related to each test. Discuss the techniques that are specifically used in toxicology and what the findings of each test signify. ~~(TN Reading 1, 2, 7; TN Writing 4, 9; TN Scientific Research 4; TN Chemistry II 3)~~

21) Identify the types of drugs that might be found in victims and/or suspects during a criminal investigation. Research and explain gas chromatography, thin-layer chromatography, mass spectrometry, ultraviolet, and infrared spectroscopy methods for identifying legal and illegal drugs. Given a case study involving drugs, select the type of laboratory analysis that would yield the appropriate information. Justify the selection with information cited from textbooks, online and print journals, and precedents identified from similar cases. ~~(TN Reading 2, 4, 7; TN Writing 4, 5, 7; TN Chemistry II 3)~~

22) Investigate the science surrounding the physical properties of matter, and explain how they are related to the forensic analysis of glass, fibers, metals, and/or paints. Apply the principles of temperature, weight and mass, density, and the refractive index in the context of forensic science. ~~(TN Reading 2, 3, 4; TN Writing 4; TN Scientific Research 3; TN Chemistry II 2)~~

23) Explain the scientific basis for identifying the presence of gunpowder residue on objects, victims, and suspects; similarly, explain how scientists identify impressions on the victim or those who have left a crime scene. Include in the explanation how to determine bullet caliber from a wound in a victim. Review cases that have been decided based on impressions and ballistic evidence, and relate how forensic science was involved. ~~(TN Reading 2, 3, 4, 8; TN Writing 2, 7, 8, 9; TN Scientific Research 2, 3, 4, 5; TN Chemistry II 3)~~

Portfolio

24) Update the portfolio started in *Health Science Education* to demonstrate mastery of skills and knowledge acquired throughout the full Biotechnology Research program of study and applied in the final course. The portfolio should reflect thoughtful assessment and evaluation of the progression of work, exhibiting personal and professional growth in the health science pathway. ~~(TN Writing 4, 5, 6)~~

The following artifacts will reside in the student portfolio:
- Career Exploration portfolio
- Skills performance rubrics
- Documentation of job shadowing hours
- Examples of written, oral, or digital presentations
- Short research project documents

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Scientific Research: Tennessee Science: Scientific Research standards 2, 3, 4, and 5 may provide additional insight and activities for educators.~~
- ~~TN A&P: Tennessee Science: Anatomy and Physiology standards 1, 2, 3, and 4 may provide additional insight and activities for educators.~~
- ~~TN Biology II: Tennessee Science: Biology II standards 2, 4, and 5 may provide additional insight and activities for educators.~~
- ~~TN Chemistry II: Tennessee Science: Chemistry II standards 2 and 3 may provide additional insight and activities for educators.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Health Science

Primary Career Cluster:	Health Science
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	0837
Prerequisite(s):	None
Credit:	N/A
Grade Level:	8
Graduation Requirements:	N/A
Programs of Study and Sequence:	This course serves as a middle school primer for all programs of study in the Health Science career cluster.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Pamela Grega, (615) 532-6270, Pamela.Grega@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://www.tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	101, 210, 211, 212, 400, 401, 402, 440, 499
Required Teacher Certifications/Training:	Middle School teachers are encouraged to coordinate the teaching of this course with the corresponding high school Health Science program.
Teacher Resources:	https://www.tn.gov/education/article/cte-cluster-health-science

Course Description

Introduction to Health Science introduces middle school students to the exciting, dynamic world of the health sciences, an industry that is rapidly changing and high in demand for workers who can think critically to solve a range of health-related problems. Students will explore healthcare systems, legal and ethical issues in healthcare and basic healthcare skills. Upon completion of this course, proficient

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students will be prepared to pursue courses in high school that lead to careers in the fields of biotechnology research, therapeutics, health informatics, diagnostics, and support services. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*

Program of Study Application

This is an exploratory course for all health science programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at https://www.tn.gov/education/article/cte-cluster-health-science.

Course Standards

Career Planning

1) Identify key innovators and contributions made in the history of health care in the United States. Create a timeline or other graphic to illustrate major developments beginning with the first medical school through today, citing sources such as textbooks or online encyclopedias. (TN Reading 1, 2; TN Writing 6, 8)

2) Prepare a paper or electronic career profile for at least one occupation in one of the five health science career areas (biotechnology research, therapeutic services, support services, health informatics, and diagnostic services), to be included as part of a health science portfolio. Document the following related to the chosen occupation:
   a. A job description synthesized from print or online sources, such as government occupational profiles
   b. A brief biography or profile of a famous person who is known for this job, or, alternatively, a short narrative about a family or community member who holds this occupation
   c. The career path, level of education attained, and any additional training this person pursued in the course of successfully reaching his/her occupational goals

   The career profile can be compiled based on information drawn from textbooks, online encyclopedias, government websites, and similar sources, or from personal interviews with the family or community member chosen for the profile. (TN Reading 1, 7; TN Writing 4, 6, 8, 9)

3) Draw evidence from occupational profiles, industry journals, and textbooks to summarize the professional traits (such as leadership, ethical responsibility, and time management) required of healthcare professionals in the twenty-first century. (TN Reading 1; TN Writing 8, 9)

Healthcare Systems

4) Identify the types of healthcare facilities in the United States. Compile a list of healthcare professionals that work in these facilities. Compare and contrast the salaries of at least three healthcare professionals in two different sites, and create a report and/or presentation on these comparisons. (TN Writing 4, 7, 8, 9)

5) Define the terms culture, ethnicity, and race. Research customs, beliefs, and practices surrounding health care from another culture, ethnicity, or race, and relate findings in a written, oral, or digital presentation. Compare and contrast how aspects such as respect, informed consent and medical decision making, medical testing, and social context vary across different cultures and populations. (TN Reading 2, 4, 8; TN Writing 4, 9)

6) Differentiate between the methods of payment for healthcare in the United States. Compare and contrast private and state/federal insurance, health savings accounts, and managed care. (TN Reading 1, 4, 9)

Body Function and Structure

7) Outline the basic normal structure and function of all body systems. Present a visual illustration of a system within the human body, listing the basic structures and using medical terminology for each. (TN Reading 2, 4)

8) Distinguish between the medical definitions of health and wellness, identifying preventive measures and behaviors that promote each. Discuss contemporary controversies to wellness theories, such as but not limited to the debates surrounding concussion evaluation of middle and high school athletes, increased use of drugs and alcohol by middle school students, and alternative diets, e.g., those geared toward dramatic weight loss. (TN Reading 2, 8)

9) Develop a patient health education presentation surrounding one of the following wellness issues: exercise and fitness, healthy eating and nutrition, sleep, the increase in food allergies, noise-induced hearing loss, or other topic approved by the instructor. Include signs and symptoms of the behavior and/or disease, major associated physical and/or mental concerns, preventive measures, and support systems. Include at least two resources drawn from textbooks, online healthcare journals, or websites (such as MedLine Plus, National Institute of Health, or the Centers for Disease Control). (TN Reading 1, 3, 8, 9; TN Writing 2, 4, 7, 9)

Infection Control/Medical Microbiology

10) Define chain of infection and provide strategies for how to break each part of the chain to prevent infection. Evaluate professional journals or news articles for examples of infectious outbreak within a community and the implications on an individual's health. Capture those findings in a written, oral, or digital presentation, citing evidence from the investigation. (TN Reading 1, 2; TN Writing 6, 7)

11) Understand the principles of and successfully perform the following skills to prevent or curtail the spread of pathogenic and non-pathogenic organisms:
    a. Hand washing
    b. Sneeze and cough prevention
    (TN Reading 3)

Foundational Healthcare Skills

12) Understand principles of and successfully perform skills related to Emergency Medicine, incorporating rubrics from American Heart Association or American Red Cross such as:

a. Basic First Aid care of bleeding and wounds
b. Basic First Aid care for burns
c. Basic First aid for bone and joint injuries
(TN Reading 3)

13) Understand principles of and successfully perform skills reacted to Medical Assisting Skills, incorporating rubrics from textbook or clinical standards of practice:
a. Temperature, pulse and respiration assessment
b. Screening for vision problems
(TN Reading 3)

14) Understand principles of and successfully perform skills reacted to Physical Therapy Skills, incorporating rubrics from textbook or clinical standards of practice:
a. Ambulation with crutches
(TN Reading 3)

15) Understand principles of and successfully perform skills reacted to Athletic Training, incorporating rubrics from textbook or clinical standards of practice:
a. Basic stretching exercises
(TN Reading 3)

16) Understand principles of and successfully perform skills reacted to Forensic Scientist, incorporating rubrics from textbook or clinical standards of practice:
a. Extraction of DNA
(TN Reading 3)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 6-8 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 6-8 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Culinary Arts I

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	5979
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the first course in the *Culinary Arts* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ SkillsUSA: http://tnskillsusa.com/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	ServSafe
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	(050 and 060), (050 and 453), (051 and 060), (051 and 453), (154 and 155), (450 and 060), (450 and 453), 562, 563, 564, 566, 730
Required Teacher Certifications/Training:	Serve-Safe, National Registry of Food Safety Professionals, or CCE Culinary Chef Educator Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Culinary Arts I equips students with the foundational knowledge and skills to pursue careers in the culinary field as a personal chef, caterer, executive chef, and food and beverage manager. Upon completion of this course, proficient students will have knowledge in the components of commercial kitchen safety and sanitation, history of the foodservice industry, careers, nutrition, recipe basics,

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proper kitchen tools and equipment, and kitchen staples. Throughout the course students will gain experience in commercial food production and service operations, while preparing for further training at the postsecondary level. Artifacts will be created for inclusion in a portfolio, which will continue throughout the full sequence of courses. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~ **In addition to implementing the following standards, the course should include a suggested 30 hours spent in a commercial kitchen laboratory**.

Program of Study Application

This is the first course in the *Culinary Arts* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality & Tourism website: https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Safety & Sanitation

1) Synthesize research from government publications such as Food and Drug Administration (FDA) Food Codes to identify the pathogens found in foods. Create an alphabetical index of pathogens, citing the research, which illustrates the required environmental factors for transmission, symptoms, and categories. ~~(TN Reading 1, 4; TN Writing 8, 9)~~

2) Summarize the requirements for proper disposal and storage of chemicals used in the commercial foodservice laboratory and adhere to laboratory work requirements throughout the course. Create or update an existing binder of Material Safety Data Sheets (MSDS) outlining how to work with chemicals and potential hazards. Develop a list of, and demonstrate, procedures to schedule when cleaning and sanitizing the commercial foodservice laboratory using the proper chemicals and disposal of waste; include the list in the student portfolio. ~~(TN Reading 2)~~

3) Compile, practice, and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government published fact sheets. Identify, review, and demonstrate general laboratory safety procedures including but not limited to prevention and control procedures of pest, insects, and rodents and personal hygiene expectations. Incorporate safety procedures and complete safety test with 100 percent accuracy; include exam in course portfolio. ~~(TN Reading 3)~~

History & Influences on the Food Service Industry

4) Articulate important historical events and milestones that influenced culinary practices from ancient times to the present. Create a timeline or other graphic to illustrate the major impacts of these culinary practices on the progression of various styles of cuisine, citing specific textual evidence from research. ~~(TN Reading 1, 2, 7; TN Writing 2, 9)~~

5) Research the growth and development of the foodservice industry, focusing on the influence of significant contributors. Craft an explanatory text to outline significant contributions and the impact on the modern day industry. Examples of significant contributors include, but are not limited to:

      a.   Maire-Antoine Careme
      b.   Auguste Escoffier
      c.   Catherine de Medici
      d.   Fernand Point
      e.   Alexis Soyer
(TN Reading 2; Writing 2, 4, 9)

6) Evaluate factors that influence the foodservice industry. Form a hypothesis about how specific factors may impact the foodservice industry. Develop claim(s) and counterclaim(s) fairly, supplying data and text-based evidence. Influential factors may include:
      a.   Economic climate
      b.   Social changes
      c.   Globalization of cuisines
      d.   Green technologies
      e.   Farm to Table
(TN Reading 1; TN Writing 1, 4)

Foodservice Careers

7) Compile and analyze real-time labor market data, including economic and demographic trends, and compare with authentic vacancy announcements on local and national job boards. Use this information to compare and contrast occupations by education requirements, job availability, salaries, and benefits. Outline an educational pathway to obtain the necessary level of education and relevant certifications for a chosen occupation in the foodservice industry, review and revise throughout the program of study. (TN Reading 2, 9; TN Writing 4)

8) Create an organizational diagram of the kitchen workstations in the brigade system, labeling each workstation with its unique list of roles and responsibilities. Examine the licensing, certification, and credentialing requirements for each position. Craft an explanatory essay describing modern variations of the brigade system and how it enhances productivity. (TN Reading 9; TN Writing 2)

9) Conduct research to develop a persuasive essay on contemporary issues and challenges facing the foodservice industry. Synthesize multiple perspectives and advance an original argument to address the issues. Develop claim(s) and counterclaim(s) fairly, supplying data and text-based evidence. Contemporary issues and challenges may include but are not limited to:
      a.   Living wage
      b.   Labor demands
      c.   Customer demands
      d.   Technology advances impacting labor needs
(TN Reading 1, 9; TN Writing 1, 7, 8, 9)

10) Compare and contrast the qualities of effective and ineffective teams. Work collaboratively to correct and refine the actions of team members to ensure productivity. Throughout the course, demonstrate teamwork, problem solving, and decision making skills when working collaboratively.

Nutrition and Health Overview

11) Identify, analyze, and visually represent the macro- and micro- nutrients required in the human diet. Include the common food sources of those nutrients, their chemical properties, and function in the body, as well as the influence upon biological systems in reference to maintenance and growth.
   a. Macro nutrients include: carbohydrates, lipids, and proteins
   b. Micro nutrients include: minerals, vitamins, and water
   (TN Reading 1, 7; TN Writing 4)

12) Differentiate between food allergies and food intolerances, and describe the body's reaction to each. Research the eight (8) most common food allergens. Make recommendations for food substitutes and recipe modifications to avoid foods that may cause a reaction, citing specific reasoning and evidence to justify the recommendation. (TN Reading 1; Writing 4)

Recipe Basics

13) Examine the anatomy of a recipe identifying the key points and functions of each (name, yield, portion size, ingredients, quantity, and methods). Define common recipe terminology. Use the definitions to gain a proficient working understanding of terms and characteristics used in the standardized recipes. (TN Reading 4, 5)

14) Compare and contrast the components of a standardized recipe with a home recipe, citing evidence from each recipe format to support comparisons. Using proper formulas, apply the correct conversation factor to increase and decrease the yield according to specifications noted in recipes. (TN Reading 3)

15) Follow recipes precisely, including defining and utilizing specific culinary and measurement terms as needed. Discuss ways to reduce waste in food products. (TN Reading 3, 4)

Kitchen Equipment

16) Identify, describe, and effectively demonstrate the use of hand tools and smallwares used in commercial food preparation. Using supporting evidence from a variety of equipment manuals and fact sheets, create an informational guide to differentiate the functions, cleaning procedures, storage, and examples of proper use of tools used in commercial foodservice. (TN Reading 1; TN Writing 2)

17) Examine various pieces of large equipment employed in commercial kitchens, including refrigeration units, holding units, grills and broilers, ranges and ovens. Explain the properties of design and their relationship to functionality for each piece of equipment examined. Determine the appropriate equipment needed for various tasks performed in the commercial kitchen, properly demonstrate safe use, and outline and practice proper cleaning procedures. (TN Reading 1)

18) Identify, and be able to select, the appropriate measuring tools (i.e. measuring cups, pitchers, spoons, scales, and thermometers) for a variety of ingredients. Execute proper measuring required for ingredients for recipes in lab settings.

Preparation Techniques

19) Distinguish among the different types of knives (i.e. paring, serrated, slicers, utility, and chef's) and explain their elements of construction. Identify and demonstrate the correct use, sharpening techniques, and storage options for each type of knife examined. Create a how-to graphic outlining the proper safety handling techniques when using knifes in the kitchen, citing evidence. (TN Reading 1, 3, 7; TN Writing 1, 9)

20) Categorize the different types of cuts by justifying how they should be used for a given recipe or presentation. Prepare a workstation for knife work. Practice and execute the three basic knife cuts (slice, stick, and dice) using the correct safety methods. Upload either a picture or video into the student portfolio documenting correct use. (TN Writing 6)

Cooking Principles

21) Using culinary resources, such as textbooks or industry magazines, compare and contrast dry, moist, and combination cooking methods in a class discussion. Create an informational artifact that describes each method, locate an example recipe for each, and demonstrate effective use of the technique in a laboratory setting. Examples may include:
   a. Blanching
   b. Baking
   c. Grilling
   d. Frying
   e. Poaching
   f. Boiling
   g. Broiling
   (TN Reading 1, 5; TN Writing 2, 4, 9)

Kitchen Staples

22) Create an index of basic seasonings, herbs, and spices used in professional kitchens. Research and cite evidence from digital text resources and culinary guides that describes the sources, varied forms, and uses in professional kitchens. Asses the cost of using fresh herbs or substituting dried herbs without affecting the quality of the final product. Provide an example of a recipe for which the substitution may be made successfully. (TN Reading 1, 4; TN Writing 2, 8, 9)

23) Distinguish the differences in form and flavor between the variety of sweeteners (i.e. sugar, molasses, honey, brown sugar, maple syrup, corn syrup, and agave nectar) from a taste test/observation in the lab setting. Discuss common substitutions for sweeteners in recipes without compromising quality, citing culinary research. (TN Reading 1, 6)

24) Compare and contrast the different types of starches used in commercial kitchens and describe the physical properties of each:
   a. Flour (all-purpose, semolina, rice flour)
   b. Cornmeal
   c. Cornstarch
   d. Arrowroot
   e. Breadcrumbs (panko, dried, and fresh breadcrumbs)

Create a chart that describes which starch is best suited for each function in the kitchen, citing an example dish. (TN Reading 1, 5; TN Writing 2, 9)

25) Research the roles of acids as ingredients in the kitchen using culinary journals and text. Form a hypothesis and design and conduct an experiment to identify the role of the acid ingredients in relations to food preparation techniques. Summarize experiment results into an argument making a claim about the impact of a selected acid ingredient on food composition. Compare results to findings in news media and note when findings support or contradict previous explanations or accounts. Acid ingredients may include but are not limited to vinegars, lemon juice, and lime juice. (TN Reading 2, 3, 8, 9; TN Writing 2, 7, 8, 9)

Garde Manger

Salads

26) Compare and contrast the different types of salads (i.e. simple, composed, and bound) and the role of the ingredients in each, citing evidence from culinary textbooks. Using print or digital resources, discuss the qualities of simple and emulsified dressings, citing examples of each. Evaluate a salad recipe, analyzing the choice of ingredients, and any proposed modifications, or substitute ingredients. Draft the recipe with modification and prepare the salad. Include the recipe and a photo of the salad in the student portfolio. (TN Reading 2, 9; TN Writing 2, 4, 9)

Sandwiches

27) Categorize the different types of sandwiches, discussing the roles of ingredients, assembly methods, and attributes. Create a recipe for a cold sandwich that reflects the local taste of your region and culinary trends. The recipe should reflect the use of local products, taste of consumers, and connections to the region. Craft an accompanying explanatory text discussing the use of the local products, connection to the region, and description of the sandwich. (TN Reading 2, 9; TN Writing 2, 8, 9)

The following artifacts will reside in the student portfolio:
- Index of pathogens
- List of procedures for cleaning and sanitizing
- Safety Exam
- History events and milestones timeline
- Contributor paper
- Educational Pathway Assignment
- Organizational diagram of work sessions
- Persuasive contemporary issues essay
- Allergy Substitution Recommendation
- Knife how-to-graphic
- Documentation of knife cuts
- Cooking Principle artifact
- Seasoning Index
- Common Substitution
- Starch chart

- Sandwich Recipe
- Salad Recipe

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Culinary Arts II

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	5980
Prerequisite(s):	*Culinary Arts I* (5979)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one credit of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the second course in the *Culinary Arts* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ SkillsUSA: http://tnskillsusa.com/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	ServSafe
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	(050 and 060), (050 and 453), (051 and 060), (051 and 453), (154 and 155), (450 and 060), (450 and 453), 562, 563, 564, 566, 730
Required Teacher Certifications/Training:	Serve-Safe, National Registry of Food Safety Professionals, or CCE Culinary Chef Educator Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Culinary Arts II is an applied-knowledge course to prepare students for careers in the culinary field as a personal chef, caterer, executive chef, and food and beverage manager. Upon completion of this course, proficient students will have an understating of commercial kitchen safety and sanitation, menu planning, food presentation, purchasing and inventory, preparation skills, cooking principles, and food preparation. Students will gain experience in commercial food production and service operations, while

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preparing for further training at the postsecondary level. Artifacts will be created for inclusion in a portfolio, which will continue throughout the full sequence of courses. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~ **In addition to implementing the following standards, the course should include a suggested 30 hours spent in a commercial kitchen laboratory**.

Program of Study Application

This is the second course in the *Culinary Arts* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality & Tourism website: https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Safety & Sanitation

1) Summarize the different ways that cross-contamination can occur in the kitchen, citing sources from the U.S. Department of Health and Human Services or other federal guidelines. Write a script and create a video or public service announcement explaining how to prevent cross-contamination in the kitchen. ~~(TN Reading 1, 6; TN Writing 6)~~

2) Identify the steps for sanitizing food-contact surfaces in the kitchen, citing evidence from textbooks, regulations, or similar collections of best practices. Compare and contrast the different types of sanitizing (i.e., heat and chemical) and distinguish when each type should be used. In small groups, inspect the classroom kitchen using the Food Service Establishment Inspection Report from the Tennessee Department of Health. ~~(TN Reading 3, 9)~~

3) Compile, practice, and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government published fact sheets. Identify, review, and demonstrate common laboratory safety procedures, including but not limited to prevention and control procedures and personal hygiene expectations. Incorporate safety procedures and complete safety test with 100 percent accuracy; include exam in the student portfolio. ~~(TN Reading 3)~~

Menu Planning

4) Compare and contrast the main types of menus (market menu, a la carte, static menu, cycle menu, and table d'hote) and synthesize basic planning principles for a variety of different restaurant menus. Apply menu planning principles to create a menu for an assigned concept, following recommendations in state truth-in-menu guidelines, or in the Nutrition Labeling and Education Act (NLEA). Incorporate appropriate service style, cuisine, and atmosphere when crafting the menu. In small groups, review the menu of peers to strengthen their overall quality through revising and editing. ~~(TN Reading 2, 9; TN Writing 4, 5)~~

5) Analyze the elements that affect food cost and labor cost in foodservice operations, citing examples from real companies. Demonstrate working knowledge of costing a recipe and predicting labor cost percentages. Craft an explanatory text illustrating the impact of such costs. Formulas include:

a. Calculating Per Pound Unit Cost (Price per Case ÷ Number of pounds in case = Per Pound)
b. Calculating Per Ounce Unit Cost (Price per Pound ÷ 16 ounces = Cost per Ounce)
c. Calculating Per Piece Unit Cost (Cost ÷ Number of Pieces = Cost per Piece)
d. Calculating Total Cost (Number of Units x Unit Price = Total Cost)
e. Calculating Edible Portion (EP) Price (As Purchased [AP] Cost ÷ Yield Percentage = Edible Portion [EP] Price)
f. Calculating Yield Percentage (Edible Portion [EP] ÷ As Purchased [AP] x 100 = Yield Percentage)
g. Calculating Labor Cost (Labor Cost ÷ Food Sales = Labor Cost Percentage)
(TN Reading 1, 7; TN Writing 2, 4; TN Math N-Q)

6) Evaluate the different methods and formulas (going rate, prix fixe, markup, and food cost percentage) that foodservice operations use to calculate the price of dishes. Select the correct formulas to calculate the menu price for an assigned dish. Formulas include but are not limited to:
a. Markup (Food Cost + Markup = Menu Price)
b. Food Cost Percentage (Food Cost per Portion ÷ Standard Food Cost Percentage = Menu Price)
(TN Math N-Q)

Presentation

7) Research and describe the plating principles that guide platter and buffet presentation, including color, height, focal point, temperature, and proportion. Apply plating principles throughout the course to design attractive platter and plate presentations. (TN Reading 1;TN Math N-Q)

8) From recipe research, create a list of commonly used edible garnishes. Create a cheat sheet of principles to remember when deciding which garnish should accompany a given dish. Examples of principles include dish temperature, functional appearance, and using garnishes sparingly. (TN Reading 1; TN Writing 7)

Purchasing, Receiving, and Inventory & Storage

9) List the factors (i.e., environmental, economic, social, and/or government regulations) that influence food prices and quality, drawing on diverse resources and perspectives including recent news media. Research the purchasing methods (i.e., bids, purchase orders, requisition, and sales quotes) that foodservice operations use to order supplies. Craft an explanatory text outlining the pros and cons of each, analyzing how such methods are used to manage food costs. (TN Reading 2, 8; TN Writing 2, 9)

10) Summarize the requirements for proper receiving and storage of food products from the U.S. Department of Agriculture and other culinary resources. Develop a brief manual on proper procedures for receiving and storage of food products, including both raw and prepared foods, justifying recommendations specific to temperature and product rotation. (TN Reading 1, 3, 5; TN Writing 4, 6, 8)

11) Investigate technology advances in foodservice management softwares, including inventory databases and employee time keeping systems. Create a basic inventory system for easy reference of par stock, recipes, ordering, and receiving of items; employ consistent documentation procedures using purchase orders and related templates. (TN Reading 2, 6; TN Writing 6)

Preparation Skills

12) Compare and contrast the size and shape of different cuts used in commercial kitchens. Practice performing different cuts using the correct steps corresponding to each. Cuts include but are not limited to:
    a. Brunosie
    b. Chiffonade
    c. Dice
    d. Julienne
    e. Mince
    f. Rondelle
    Either record a video or take a picture to demonstrate mastery of techniques to place in the student portfolio. Execute proper safety and cutting techniques when using knives in the lab. (TN Reading 3)

Cooking Principles

13) Define the three classifications of cooking methods (combination, dry, and moist), citing an example of each. Discuss how heat is transferred by conduction, convection, and radiation, incorporating evidence from kitchen equipment manuals or textbooks. Compare the uses of these techniques in the kitchen laboratory to their explanations in texts. (TN Reading 2, 5, 9)

14) Select three pieces of a food (i.e., a piece of chicken, apple, or potato). Form a hypothesis regarding what happens when that food is overcooked or undercooked using a certain cooking method. Conduct an experiment to test the hypothesis. Report results in an explanatory text outlining the physical change in appearance, flavor, texture, weight, and moisture of the food. (TN Reading 3, 9; TN Writing 2)

Food Preparation

For each of the following food types, prepare a "cheat sheet" to include as part of a food preparation index in the student portfolio. The index will address forms, preparation methods, classification and grading processes, receiving and storage practices, and a sample standardized recipe and photograph of the prepared dish. For each entry, draw on relevant culinary research and guidelines from regulatory agencies and organizations to support information included in the index.
Fruits

15) Research the classification of fruits and cite an example of a fruit from each classification commonly used in commercial foodservice, including those often mistaken as vegetables. Referring to research from the U.S. Department of Agriculture (USDA), categorize the grades that fruit may be purchased in, note its primary growing season, and explain the different forms available to consumers. (TN Reading 1, 4; TN Writing 9)

16) From recipes, summarize the steps to prepare and/or cook fruits when preparing dishes, displays, and garnishes. Draw on basic chemistry principles to explain the process of oxidation and the importance of acidulation when preparing certain fruit dishes. Select a fruit recipe and modify the recipe to incorporate fruits that are currently in season. (TN Reading 3, 7; TN Writing 4, 9)

17) Write a research paper or conduct a research project on a current culinary topic or issue affecting the foodservice industry, using appropriate digital search resources and academic writing. Topics may include but are not limited to:
    a. Organic fruits versus nonorganic fruits
    b. Technologies for preserving fruits (canned, frozen, and dried)
    c. Buying local
    d. Traceability of produce (i.e., carbon footprint)
    e. Acidulating fruits
(TN Reading 2, 6; TN Writing 7)

Vegetables

18) Distinguish among the most commonly used vegetables in commercial foodservice. For each vegetable examined, describe its anatomy and use based on information gathered in culinary textbooks. Evaluate the quality factors when selecting vegetables, including growing seasons and regions, available forms of purchase, and vegetable gradings, citing relevant research from government authorities where appropriate. Compile a collection of standardized recipes that demonstrates the diverse cooking methods employed in foodservice settings. (TN Reading 1, 4; TN Writing 6)

19) Summarize various moist-heat and dry-heat cooking methods from the collection of standardized recipes gathered in standard 18. Research the principles of vegetable cookery using culinary journals and magazines to identify the factors that affect the flavor, texture, color and retention of nutrients in cooked vegetables. Select the best cooking method for a chosen vegetable, justifying the selection based on the evidence. (TN Reading 1, 4; TN Writing 2, 9)

20) Form a hypothesis and design and conduct an experiment to determine the role of acid and alkaline solutions in a vegetable's color during the cooking process. Summarize experiment results into an argument making a claim about the impact of a selected solution ingredient on vegetable composition. Compare results to findings in news media and culinary journals, and note when findings support or contradict previous explanations or accounts. (TN Reading 3, 4, 9; TN Writing 1, 7, 9)

Stocks, Soups, & Sauces

21) Research and summarize the roles of a variety of ingredients in the production of stocks (i.e., white stock, brown stock, broth/bouillon, vegetable stock, and fish stock). Compare the characteristics of the stocks, cooking times, and ingredients' contributions to the flavor profile. Create a list of steps to execute when making stocks and bases. Demonstrate the skill of making

stock and evaluating the quality of the finished product by following the multistep procedure created above. (TN Reading 1, 3, 4; TN Writing 2)

22) Compare and contrast the types of soups (i.e., clear soups, thick soups, and specialty soups). Follow and continually modify soup recipes to create a variety of soups for a given menu. Justify with the advantages and disadvantages of serving different types of soups for certain menus. (TN Reading 3)

23) Synthesize the characteristics of the mother sauces and derivative sauces. Justify from culinary textbooks and other sources how to choose a thickening agent when preparing different sauces, citing evidence from recipes. Create a recipe for a sauce and prepare the sauce. (TN Reading 2, 3, 5; TN Writing 4)

Starches

24) Synthesize from culinary research the different types of starches used in commercial kitchens, including but not limited to potatoes, grains, corn, rice, and wheat. Identify how the starch content determines botanical differences among starches and influences how cooks select them for dishes. Compile a collection of standardized recipes that demonstrates the diversity of starches in foodservice settings. (TN Reading 1, 4)

25) Compare and contrast the differences in appearance, flavor, and texture of fresh pasta and dry pasta. Research a fresh pasta recipe from the Internet. Using the recipe, make modifications to create an original multistep recipe, demonstrating proper safety techniques throughout. (TN Reading 9; TN Writing 5)

The following artifacts will reside in the student's portfolio:
- Safety and Sanitation assignment
- Sample menu
- Collection of recipes
- Receiving and storing manual
- Cooking principle results
- Cheat sheets
- Research papers
- Pictures of skills

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Culinary Arts III

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	5981
Prerequisite(s):	*Culinary Arts II* (5980)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the third course in the *Culinary Arts* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ SkillsUSA: http://tnskillsusa.com/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	ServSafe
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	(050 and 060), (050 and 453), (051 and 060), (051 and 453), (154 and 155), (450 and 060), (450 and 453), 562, 563, 564, 566, 730
Required Teacher Certifications/Training:	Serve-Safe, National Registry of Food Safety Professionals, or CCE Culinary Chef Educator Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Culinary Arts III is an advanced course intended to further equip students with the skills and knowledge needed to pursue a variety of careers in the culinary field. Upon completion of the course, students will be proficient in components of commercial kitchen safety and sanitation, dining room service, food preparation and presentation, bakeshop preparation skills and equipment, and advanced cooking principles. Students will gain experience in commercial food production and service operations, while

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preparing for further training at the postsecondary level. Artifacts will be created for inclusion in a portfolio, which will continue throughout the full sequence of courses. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~ **In addition to implementing the following standards, the course should include a suggested 30 hours spent in a commercial kitchen laboratory**.

Program of Study Application

This is the third course in the *Culinary Arts* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality & Tourism website at https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Safety & Sanitations

1) Analyze the concepts and principles of the Hazard Analysis and Critical Control Points (HACCP) program approach to food safety from the Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA) in relation to meats and seafood. Create an informational graphic to summarize the program's approach and demonstrate ability to follow procedures outlined within. ~~(TN Reading 2, 3, 7)~~

2) Compile, practice, and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government published fact sheets. Identify, review, and demonstrate common laboratory safety procedures, including but not limited to prevention and control procedures and personal hygiene expectations. Incorporate safety procedures and complete safety test with 100 percent accuracy; include exam in the student portfolio. ~~(TN Reading 3)~~

Dining Room Service

3) Drawing on examples from culinary blogs and websites, compare and contrast a range of service styles (i.e., buffet, American service, Russian service, and French service) used in modern-day dining rooms. Evaluate when each style would be appropriate for a given audience, setting, or event, and create a presentation to share findings with the class. ~~(TN Reading 6, 9)~~

4) Demonstrate the ability to properly preset a dining area according to one of the commonly used place settings (i.e., American, a la carte, and banquet). Evaluate the different styles to fold napkins and select one style to demonstrate in a peer teaching environment. ~~(TN Reading 3)~~

Food Preparation

For each of the following food types, prepare a "cheat sheet" to include as part of a food preparation index in the student portfolio. The index will address forms, preparation methods, classification and grading processes, receiving and storage practices, and a sample standardized recipe and photograph of the prepared dish. For each entry, draw on relevant culinary research and guidelines from regulatory agencies and organizations to support information included in the index.
Dairy & Eggs

5) Synthesize research from the National Dairy Council to determine the composition of milk. Summarize in a graphic the percentage of required butterfat content in various milk products and high butterfat dairy products. In the graphic, include a description of which product is best suited for different functions in the kitchen; outline guiding principles when cooking with milk, citing evidence from an example dish. (TN Reading 2, 4, 7; TN Writing 4)

6) Identify the three most common milk products (i.e., evaporated milk, sweetened condensed milk, and dried milk powder) used in the foodservice industry. Compare and contrast the different concentrations and compositions of each. Compile a collection of recipes in which each product (independently or in combination) may be used. (TN Reading 1, 9)

7) Research the history and use of cultured dairy products from early civilizations to the present. Outline the processes used in culturing, noting the different types of bacteria that are added to the milk to create each product. Compare the taste, ingredients, and cost of different cultured dairy products, and explain these differences to a peer audience as would a foodservice professional. (TN Reading 2, 4, 9; TN Writing 4, 7)

8) Compare and contrast the chemical properties of butter and margarine, citing evidence pertaining to molecular structure, nutritional facts, and nutritional claims. Justify why foodservice kitchens use clarified butter in place of butter substitutes. Demonstrate the multistep procedure for clarifying butter, noting temperature and time during each step. (TN Reading 3, 9; TN Writing 2, 7)

9) Research the cheese making process, describing how various stages of the process impact the flavor, shape, and color of cheese. Compare and contrast the roles of coagulants, bacteria, curds, and whey in different cheese types (i.e., fresh, soft, medium, firm, hard, blue, processed, and stretched cheese). Demonstrate the process of making cheese or yogurt product by following a multistep recipe. (TN Reading 3, 9; TN Writing 7)

10) Referring to research from sources such as the American Egg Board or the Incredible Egg website, summarize the anatomy of eggs, and categorize the forms, grades, and sizes in which eggs may be purchased. Evaluate the storage procedures and principles, especially noting the temperature, time, and storage considerations concerning an egg's porous shell. Compile a collection of recipes highlighting the diverse role of eggs in commercial kitchens. (TN Reading 2, 4, 5, 7; Writing 6)

Meats & Poultry

11) Identify major species and breeds of livestock and poultry utilized for meat production. Describe the composition of the meat (i.e., muscle, connective tissues, fat, and bones) and its impact on the quality analysis of the meat, including, but not limited to, marbling. Write an informative text summarizing the effects of aging on the texture of meats and poultry. (TN Reading 1, 5; TN Writing 2, 9)

12) Analyze the United States Department of Agriculture (USDA) inspection and grading procedures for meat. Summarize how meats are graded, classified, and inspected. Examine how meat carcasses are cut into primal and subprimal cuts of meats, outlining the importance of uniform portioning. (TN Reading 2, 4, 9; TN Writing 4, 8)

13) Summarize how poultry is classified by bird type, size, and age in the foodservice industry. Craft an explanation supporting how the size of poultry items affects the portion control, tenderness, and cost of dishes. Calculate the price of a whole bird compared to the cost of purchasing individual pieces by fabricating a whole chicken. (TN Reading 1; TN Writing 2; TN Math N-Q)

14) Compare and contrast the differences in mechanical and chemical tenderizers used in meat preparation. Discuss how the cut of meat influences the type of tenderizer and cooking method used when preparing. Research and develop a corresponding data table for the proper cooking methods of each cut. (TN Reading 7, 9)

Bakeshop Basics

15) Identify, describe, and effectively demonstrate the use of hand tools and smallwares used in the bakeshop area of the commercial kitchen. Using supporting evidence from a variety of equipment manuals and fact sheets, create an informational guide to differentiate the functions, cleaning procedures, storage, and examples of proper use of tools used in commercial foodservice. (TN Reading 1, 4, 9; TN Writing 2, 4, 9)

16) Compare and contrast the variety of mixing methods used in commercial kitchens. Demonstrate and practice these methods determined by the nature of the ingredient and desired product. Mixing methods include, but are not limited to:
   a. Beat
   b. Blend
   c. Creaming
   d. Cut in
   e. Fold
   f. Knead
   g. Whip
   Either record a video or take a picture to demonstrate mastery of techniques to place in the student portfolio. Execute proper mixing techniques when mixing ingredients in labs. (TN Reading 3, 7)

17) Summarize from recipes and other culinary resources the differences in baking ingredients used in commercial kitchens, and describe the physical properties of each:
   a. Flour (high-gluten, bread flour, all-purpose, pastry, cake, whole wheat, self-rising, rye flour)
   b. Sweeteners (granulated sugar, powdered sugar, brown sugar, molasses, honey, and corn syrup)
   c. Shortening
   d. Leavening agents (chemical and yeast)
   e. Chocolate (powder, butter, and coating)
   Create a chart that describes which ingredients are best suited for each function in the bakeshop, citing an example dish with claims from research that supports the rational provided. (TN Reading 2, 4; TN Writing 1)

Bakeshop Preparation

Quick versus Yeast Breads

18) Summarize the differences in yeast breads, quick breads, and traditional batters, noting the differences in leaveners, preparation/mixing methods, and baking methods. Create an outline of the scientific processes that occur in mixing, kneading, and proofing yeast breads. (TN Reading 2, 5; TN Writing 2)

19) Compile a collection of recipes from multiple sources that illustrates the diversity of bread products in commercial kitchens. Demonstrate proper preparation methods to prepare one or more of the selected recipes. (TN Reading 3)

Cookies

20) Summarize and practice the two main mixing methods (one-stage and creaming) of cookies from sample recipes, notating the multiple steps involved. Analyze the forming techniques of cookies (i.e., drop, rolled, spritz/pressed, sheet, icebox, and bar), and describe how each contributes to the overall appearance, flavor, and texture, citing evidence from culinary textbooks and research gathered in the kitchen laboratory. (TN Reading 1, 2; TN Writing 2, 4, 9)

21) Compile a collection of cookie recipes from multiple sources. Develop an original recipe, taking into consideration the ingredient proportions, flavor profile, and presentation of the final product. In small groups, review and revise the recipes of peers. Take a photograph of the prepared cookie and place in the student portfolio. (TN Reading 7; TN Writing 5)

Pies and Tarts

22) Differentiate the distinguishing qualities of pies and tarts. Research different piecrust recipes and the 3-2-1 dough method, making note of the multistep procedures and paying close attention to the ingredients, temperature and mixing methods, and rolling and forming steps. Evaluate a variety of pie crusts using different preparation methods. (TN Reading 1, 3; TN Writing 9)

23) Summarize the different types and characteristics of pie fillings (i.e., fruit, liquid, cream, and chiffon fillings), citing examples from recipes and cookbooks. Synthesize information concerning the chemical changes that happen when certain thickening agents are used. Examples of thickeners include:
   a. Cornstarch in fruit pies
   b. Arrowroot in fruit pies
   c. Eggs in liquid fillings
   (TN Reading 1, 9; TN Writing 2)

24) Choose a fruit tart recipe from an online collection approved by the instructor. Using the recipe, make modifications to create an original multistep fruit tart recipe that follows proper safety guidelines. Outline recommendations to select a fruit for garnishing. Support recommendations by explaining the process of oxidation and the importance of acidulation when using certain fruits. (TN Reading 7, 9; TN Writing 1, 4, 9)

25) Evaluate through taste test/comparison the differences between in-house made and convenience bakeshop products for taste, price, and appearance. Using a vendor website or catalog, compare the cost of the convenience product to the in-house made products. In a presentation, make a final recommendation for which product would be appropriate for a given situation or event, citing considerations such as cost-effectiveness, flavor, presentation, and intended audience. ~~(TN Reading 9; TN Writing 1, 9; TN Math N-Q)~~

The following artifacts will reside in the student's portfolio:
- Safety and Sanitation assignments
- Dining Room Service artifacts
- Collection of recipes
- Dairy and eggs artifacts
- Meat and poultry artifacts
- Bakeshop basic artifacts
- Pictures of skills

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Culinary Arts IV

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6167
Prerequisite(s):	*Culinary Arts III* (5981)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Culinary Arts* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ SkillsUSA: http://tnskillsusa.com/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	ServSafe
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	(050 and 060), (050 and 453), (051 and 060), (051 and 453), (154 and 155), (450 and 060), (450 and 453), 562, 563, 564, 566, 730
Required Teacher Certifications/Training:	ServSafe, National Registry of Food Safety Professionals, or CCE Culinary Chef Educator Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Culinary Arts IV is the capstone course in the *Culinary Arts* program of study intended to prepare students for careers such as personal chef, caterer, executive chef, and food and beverage manager. Course content covers the components of commercial kitchen safety and sanitation, food presentation, bakeshop preparation skills, sustainability practices, professionalism, and business opportunities. Upon completion of this course, proficient students will have applied the full range of knowledge and skills

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acquired in this program of study toward the planning and catering of an event approved by the instructor. Artifacts will be created for inclusion in a portfolio, which will continue throughout the full sequence of courses. ~~Standards in this course are aligned with Tennessee Common Core State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~ **In addition to implementing the following standards, the course should include a suggested 30 hours spent in a commercial kitchen laboratory**.

Program of Study Application

This is the final course in the *Culinary Arts* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality & Tourism website at: https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Safety & Sanitation

1) Analyze the concepts and principles of the Hazard Analysis and Critical Control Points (HACCP) program approach to food safety from the Food and Drug Administration (FDA) and United States Department of Agriculture (USDA) in relation to meats and seafood. Demonstrate the concepts and principles in the foodservice setting to ensure food safety when working with meats and seafood. ~~(TN Reading 2, 3)~~

2) Research the state laws and rules that govern foodservice businesses, including catering operations, from the Tennessee Department of Health (TDH). Demonstrate adherence to all applicable laws in the course of completing the capstone project. ~~(TN Reading 1, 9)~~

3) Compile, practice, and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government published fact sheets. Identify, review, and demonstrate common laboratory safety procedures, including but not limited to prevention and control procedures and personal hygiene expectations. Incorporate safety procedures and complete safety test with 100 percent accuracy; include exam in the student portfolio. ~~(TN Reading 3)~~

Food Preparation

For each of the following food types, prepare a "cheat sheet" to include as part of a food preparation index in the student portfolio. The index will address forms, preparation methods, classification and grading processes, receiving and storage practices, and a sample standardized recipe and photograph of the prepared dish. For each entry, draw on relevant culinary research and guidelines from regulatory agencies and organizations to support information included in the index.

Fish & Shellfish

4) Identify the major types of shellfish and finfish (saltwater and freshwater) used in commercial foodservice, citing research from government resources such as the United States Department of Agriculture (USDA) Food List or the United States Food and Drug Administration (FDA) approved list. Summarize guidelines from sources such as the United States Department of

Agriculture (USDA) Food Fact sheets for assessing the quality and freshness of finfish and shellfish. (TN Reading 1, 5, 9)

5) Analyze the National Oceanic and Atmospheric Administration (NOAA) inspection and grading procedures for finfish and shellfish. From the research, summarize how the products are graded, classified, and inspected. Examine the United States Food and Drug Administration's (FDA) list of approved acceptable market names and seek additional research to clarify unfamiliar products. (TN Reading 2, 4)

6) Create a diagram/graphic of the different fabrication forms that chefs may work with in a commercial kitchen. Summarize the various moist-heat and dry-heat cooking methods from a collection of seafood recipes. Research the principles of finfish and shellfish cookery using culinary journals and magazines. Select the best cooking method for certain finfish and shellfish, and be able to explain to a potential customer, client, or supervisor how the cooking method achieves the desired flavor profile, texture, and presentation. (TN Reading 1, 7; TN Writing 2, 4, 6)

7) Create an entrée menu listing for a finfish or shellfish dish to be served in a restaurant. The entrée listing should reflect the use of local products and connections to a certain region. Craft an accompanying explanatory text discussing the use of the local products and connection to the region. (TN Reading 2, 4; TN Writing 2, 4, 9)

Bakeshop Preparation

Cakes

8) Categorize the different types of cakes by identifying their mixing methods (i.e., creaming and sponge), the functions of their ingredients, and the methods for preparing the pan for baking. Compile a collection of cake recipes into an index. Select one recipe to demonstrate the preparation method for a group, using proper culinary terminology to narrate and explain the procedure. (TN Reading 3, 5, 7; TN Writing 9)

9) Summarize from recipes and culinary textbooks the steps to follow when assembling a multilayer cake. Identify and use the kitchen tools needed to successfully practice the skill. Using resources ranging from baking blogs to industry magazines, investigate current trends in finishing and decorating cakes. Craft an essay presenting claims and counterclaims concerning the best method for assembling a multilayer cake. (TN Reading 1, 3, 7; TN Writing 1, 4)

Custards, Foams & Buttercreams

10) Compare and contrast the different types of custards (stirred and baked) and foams (whipped cream, meringue, mousse, and Bavarian crème) commonly used in commercial foodservice. Discuss how the preparation methods affect the appearance, volume, and weight of foams. Compile a collection of recipes illustrating the diversity of custards and foams in the foodservice industry. (TN Reading 6, 9; TN Writing 6, 8)

11) Research the two types of buttercream (American and French) and the multistep process for preparing each. In a taste test/observation, compare the taste, structure, and composition of

each. Create and continually revise the recipes for different types of buttercream. (TN Reading 1, 3, 8; TN Writing 4, 5, 7)

Desserts Sauces & Frozen Desserts

12) Citing evidence from a variety of recipes and/or culinary textbooks, analyze the different types of dessert sauces (i.e., crème anglaise, chocolate, caramel, and fruit sauces) and the role of the ingredients used in each. Evaluate a range of dessert dishes that may benefit from the addition of various sauces. Demonstrate ability to prepare sauces from recipes, making modifications when needed. Evaluate the sauces for proper appearance, flavor, and texture. (TN Reading 1, 3, 5; TN Writing 5)

13) Using print or digital resources, discuss the qualities of frozen desserts, citing examples of each. Evaluate a frozen dessert recipe, analyzing the choice of ingredients. Outline any proposed modifications, including substitute ingredients. (TN Reading 1, 4, 9; TN Writing 5)

Sustainability in the Kitchen

14) Research the principles of green design, responsible design, and sustainable design in the commercial kitchen setting. Examine how a foodservice establishment has successfully implemented one of these principles, and discuss the impact it has had on the business. (TN Reading 2, 4; TN Writing 2, 4, 6)

15) Research the importance of sustainable practices in the foodservice industry. Create a plan to reduce foodservice waste and to minimize the impact on the environment. The plan should focus especially on reducing water and conserving energy. (TN Reading 2, 9)

Professionalism, Ethics, and 21st Century Skills

16) Search for the resumes of professional chefs and foodservice professionals retrieved from the websites of institutions, organizations, or professional networks. Discuss what is typically included in the resumes of foodservice professionals, compare and contrast several examples, and create a personal resume modeled after elements identified in the search. (TN Reading 1, 4, 5, 6; TN Writing 4)

17) Participate in a mock interview. Prior to the interview, prepare a paper that includes the following: tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Upon completion of the interview, write a thank you letter to the interviewer in a hand-written or email format. (TN Reading 2; TN Writing 4)

Business Opportunities

18) Compare and contrast types of business ownership models, including at minimum the following: sole proprietorships, partnerships, small businesses, cooperatives, limited liability corporations, and corporations. In a narrative referencing foodservice examples, explain the organizational structure of each model and describe its advantages and disadvantages to both owner and customer. (TN Reading 4, 5, 9; TN Writing 2, 4, 7, 9)

19) Investigate methods for reducing costs in the commercial kitchen, including but not limited to investments in energy-saving technologies, bulk purchasing strategies, and buying local. Using supporting graphic illustrations and calculations, develop a proposal for a mock client or manager, outlining how the business can save money while also adhering to its mission, without compromising the quality of food or service. (TN Writing 4; TN Math N-Q)

Capstone Project

20) Evaluate which foodservice strategies are appropriate for certain events (i.e., banquets, receptions, lunches, etc.). Compare and contrast successful strategies used by event planning and catering companies, drawing on profiles of these companies and other evidence from industry magazines, blogs, news articles, or textbooks. As part of the class capstone project, investigate potential clients for a catering event, and collaboratively determine which client would be appropriate, given classroom constraints. Potential clients could include, for example, a local non-profit or community organization, a parent-teacher association, student government association, sports team, and more. (TN Reading 2, 9)

21) Collaboratively, develop a *professionalism* evaluation rubric with performance indicators for each of the following professional attributes and use it to evaluate course assignments and personal work:
    a. Attendance/punctuality
    b. Professional dress and behavior
    c. Positive attitude
    d. Collaboration
    e. Honesty
    f. Respect
    g. Responsibility
    h. Appropriate technology use
    Share the rubric with the client for evaluation purposes as part of the capstone project.

22) Research how event planning and catering companies submit proposals to potential clients, and compare and contrast sample proposals in a variety of formats. Determine the central components necessary for any foodservice-related proposal (e.g., a projected budget). Develop an original event proposal, as approved by the instructor. The proposal should include at minimum the following:
    a. Introduction
    b. Theme of event
    c. Timeline of planning
    d. Appropriate tablewares, lines, and decorations
    e. Menu
    f. Budget/cost analysis
    g. Professionalism evaluation rubric
    (TN Reading 1; TN Writing 4, 7, 9; TN Math N-Q)

23) Present the event proposal to the client, asking for feedback and recommendations. Analyze the feedback and recommendations to justify any changes to the event proposal, citing evidence from the initial presentation. Submit the final event proposal for approval, documenting all changes made. (TN Reading 5, 9; TN Writing 4, 5)

24) Using the final approved event proposal, execute the timeline to demonstrate teamwork, problem-solving, and decision-making skills. Work collaboratively to ensure that the needs and expectations of the client are met for the event. In a personal journal entry, document the capstone experience, drawing on the connections between the project and course content. ~~(TN Writing 4)~~

25) Compile and interpret the evaluation rubric and feedback from the client, reading the results closely to allow for critical analysis and reflection. Upon conclusion of the capstone project, craft a reflection paper discussing the experience and its impact on career growth. Use technology to create a class presentation showcasing highlights, challenges, and lessons learned from the capstone. ~~(TN Reading 2; TN Writing 2, 6, 7)~~

Portfolio

26) Update the portfolio started in *Culinary Arts I* to demonstrate mastery of skills and knowledge acquired throughout the full *Culinary Arts* program of study and applied in the final course. The portfolio should reflect thoughtful assessment and evaluation of the progression of work, exhibiting personal and professional growth in the culinary field. ~~(TN Writing 4, 5)~~

The following artifacts will reside in the student's portfolio:
- Safety and Sanitation assignments
- Fish and shellfish artifacts
- Recipes
- Photos of food product
- Bakeshop artifacts
- Sustainability assignment
- Professionalism artifacts
- Capstone project artifacts

Standards Alignment Notes
*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~

- o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Hospitality & Tourism Exploration

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	5933
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the first course in the *Hospitality & Tourism Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Upon completion of the Program of Study, students will be prepared to pursue Certified Hospitality & Tourism Management Professional (CHTMP) and Certified Tourism Ambassador (CTA) certifications.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Hospitality & Tourism Exploration is a foundational course for students interested in careers within the hospitality industry. The course allows students to explore the career opportunities and fundamental principles that guide the organization and management of hospitality and tourism services. Upon completion of this course, students will be proficient in the foundations of hospitality and tourism, the segments of the industry, business concepts and operations, careers, and customer relations. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*

Approved January 30, 2015; Amended April 15, 2016

Program of Study Application

This is the first course in the *Hospitality & Tourism Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality & Tourism website at https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Foundations of the Hospitality Industry

1) Gather and analyze information from multiple authoritative sources to assess the impact of important cultural and societal events on the evolution of the hospitality industry. Examples of events include, but are not limited to: National Park Service Organic Act, National Historic Preservation Act, the emergence of new modes of transportation, the Internet and social media, and disasters such as the BP oil spill in the Gulf of Mexico. (TN Writing 7, 8, 9)

2) Evaluate a challenge or trend that influences the hospitality industry today. Form a hypothesis about how specific factors may impact hospitality, recreation, and tourism. Develop claim(s) and counterclaim(s) fairly, supplying data and text-based evidence. Research topics may include:
   a. Delivering consistent service
   b. Diversity of the workforce
   c. Demographic trends of customers
   d. Impact of seasons/weather
   e. Globalization
   f. Political conditions
   g. Economic conditions
   h. Technology trends
   (TN Reading 1; TN Writing 1, 4, 7)

Hospitality Industry Segments

3) Identify the different segments of the hospitality industry and an example of a business or organization that represents each. Cite research from internet resources, such as the local chamber of commerce, visitor's bureau, or the Tennessee Department of Tourism to explain the diverse characteristics and importance of each segment in relation to the local, state, and national economies. (TN Reading 2)

4) Citing research from the United Nations World Tourism Organization (UNWTO) or similar sources, define and explain the roles of a tourist, domestic tourist, and international tourist in the hospitality industry. Explore the different types of tourism (i.e., sustainable development, ecotourism, heritage tourism, local interest, and voluntourism) that make up the industry, drawing on resources such as the National Park Service, Habitat for Humanity, or the Center on Ecotourism and Sustainable Development (CESD). Create a public service announcement (PSA) about an assigned segment of tourism, highlighting its key characteristics and features. (TN Reading 1, 4, 5; TN Writing 4, 6, 9)

5) Compare and contrast the characteristics of the lodging businesses (i.e., full-service hotels, limited-service properties, and specialty accommodations) available in the global market by searching websites of sample businesses and noting key differences. Citing evidence of their services, create a presentation for peers describing a specific event and making a claim about the type of lodging business that would be most appropriate for hosting it. (TN Reading 1, 9; TN Writing 1, 4, 6)

6) Research the food and beverage segment of the hospitality industry, comparing and contrasting the two main groups (commercial and noncommercial). Describe the role the foodservice industry plays within the larger hospitality industry, noting its relationship and overlap with other segments (such as tourism and entertainment), by creating a presentation or graphic that illustrates evidence of the relationships. (TN Reading 2, 7, 9; TN Writing 2)

7) Investigate the agencies and professions associated with the travel segment of the hospitality industry, including but not limited to AAA. Citing evidence from case studies or sample scenarios, use the five W's of travel (i.e., who, what, when, where, and why) to plan a trip, comparing transportation types, lodging businesses, and recreation options. Craft an explanatory text that justifies the trip decisions. (TN Reading 1, 2, 9; TN Writing 2, 4, 9)

Business Concepts and Operations

8) Describe the role of profit in the economy. Using correct terms, explain the importance of productivity and its impact, along with other economic indicators, in determining business cycle stages and on making business decisions. Draw conclusions about how the hospitality industry in particular is impacted by the health of the economy at large. (TN Reading 4, 5; TN Writing 9)

9) Describe the nature and types of hospitality businesses. Contrast how for-profit and non-profit hospitality businesses are different from each other in terms of their missions, organizational structures, compensation models, and tax statuses. Examine how different segments of hospitality support each other. For example, examine the interdependence of lodging, food and beverage, and transportation businesses during an event such as a heritage festival, sporting competition, or concert. (TN Reading 1, 9; TN Writing 8)

10) Attend a local business-sponsored community event or explore case studies illustrating the social responsibilities of today's businesses. Write a reflection paper summarizing observations; specifically, evaluate how businesses benefit from engaging in responsible business practices, including benefits to the community, the environment, the marketplace, and the business/workplace itself. (TN Reading 8; TN Writing 2, 4, 8)

Careers in Hospitality & Tourism Management

11) Compile and analyze real-time labor market data, including economic and demographic trends, and compare with authentic vacancy announcements on local and national job boards. Use this information to compare and contrast occupations by education requirements, job availability, salaries, and benefits. Outline an educational pathway to obtain the necessary level of education and relevant certifications for a chosen occupation in the hospitality industry. (TN Reading 2, 9)

12) Propose an appropriate career in the hospitality and tourism industry, justifying why that opportunity is a logical fit based on the results of career aptitude survey(s) and research conducted using the Occupational Outlook Handbook. ~~(TN Reading 1; TN Writing 9)~~

Understanding Customer Relations

13) Describe the different levels of human needs and articulate how each need may be met through the hospitality and tourism industries. Compile evaluations of customer survey examples from different organizations to create a customer survey proposal for a hospitality business that collects information necessary to meet a specific purpose. ~~(TN Reading 2, 6, 9; TN Writing 1, 6)~~

14) Determine the correlation between customer-focused business practices and customer satisfaction by analyzing the importance of customers in the hospitality industry, exploring articles or profiles of businesses that are recognized for their customer service, and investigating the habits and characteristics of employees that make such businesses successful. Synthesize identified practices to create a rubric of employee characteristics that could be used as a self-assessment. ~~(TN Reading 2, 5, 9; TN Writing 4, 7, 8, 9)~~

15) Develop and practice communication skills vital to customer relations, such as active listening, and nonverbal, verbal, and written communication. Practice communication skills by participating in role-play exercises about handling customer complaints and critiquing the role-play exercises of others. ~~(TN Reading 3)~~

16) Make and defend judgments about strengthening a company's relationship with its customers by identifying successful practices outlined by a guest speaker from a local business or organization, including frequency and types of contacts, value-added services to be offered, and other activities, including social media marketing, aimed at improving customer satisfaction, loyalty, and advocacy. ~~(TN Reading 1, 2, 6, 8; TN Writing 4, 8, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Hospitality Marketing

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6169
Prerequisite(s):	*Hospitality & Tourism Exploration* (5933)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the second course in the *Hospitality & Tourism Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Upon completion of the program of study, students will be prepared to pursue Certified Hospitality & Tourism Management Professional (CHTMP), and Certified Tourism Ambassador (CTA) certifications.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Hospitality Marketing builds on the foundations learned in *Hospitality & Tourism Exploration* and introduces new topics related to the marketing of services in the hospitality industry. Students will develop proficiency in economic awareness, the role of marketing in the industry, the components of a marketing plan, and promotional concepts, all within the context of hospitality businesses. Upon completion of this course, proficient students will be prepared to pursue advanced coursework in the *Hospitality & Tourism Management* pathway. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee Economics standards.*

Approved January 30, 2015; Amended April 15, 2016

Program of Study Application

This is the second course in the *Hospitality & Tourism Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality and Tourism website at https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Economic Awareness in Hospitality

1) Explain the concept of economy, delineating between micro and macroeconomic principles; discuss how scarcity and factors of production require nations to make economic choices. Compare and contrast how the various economic systems (traditional, market, command, mixed) try to answer the questions: "What to produce? How to produce it? For whom to produce?" (TN Reading 2, 5; TN Economics 2, 4)

2) Drawing on resources such as the Tennessee Department of Labor and Workforce Development, investigate the current economic situation in a county with a hospitality industry presence and compare it to the economic situation for the state and/or nation. Write a report on the findings, citing evidence from sources researched. Discuss how the hospitality industry contributes to the local economy, including its effect on employment and consumers. (TN Reading 1; TN Writing 2, 4, 5)

3) Explain the theory of supply and demand by diagramming a hospitality or tourism business in a certain location, using reliable resources such as the Tennessee Department of Economic and Community Development. Use the price listed at the time of the assignment as the equilibrium price; show the impact on price due to an increase (peak season) or decrease (off season) in demand or supply. (TN Reading 7; TN Writing 4; TN Math N-Q; TN Economics 2, 4)

4) Produce a graphic illustration of the business cycle (recession, depression, recovery, and peak) and describe what happens to the economy at each stage of the business cycle. Cite examples of how prices fluctuate at each stage of the cycle, and discuss the impact on both consumers and businesses within the context of hospitality segments, presenting claims and counterclaims persuasively from research. (TN Reading 2, 4; TN Writing 1, 6, 9; TN Economics 2, 4)

The Role of Marketing

5) Compare and contrast the meaning of the terms marketing and advertising. Describe each marketing core function (i.e., channel management, marketing information management, market planning, pricing, product service management, promotion, and selling). Supply examples of how each of these functions supports the marketing concept in the hospitality and tourism businesses. (TN Reading 2, 4, 5; TN Writing 4)

6) Investigate the impact of cultural diversity on the hospitality and tourism industry. Discuss the components of cultural diversity, including religious customs, dietary habits, and traditions. Create a presentation to increase multicultural awareness as a strategy to accommodate consumers. (TN Reading 2, 4, 5; TN Writing 4)

7) Examine the marketing mix and relate how hospitality businesses conduct marketing research. Select a service and construct a visual representation with details and examples illustrating each of the four P's of the marketing mix (product, price, promotion, and place) and the four C's of hospitality (consumer, cost, communications, and convenience) as they relate to the selected service or business in the hospitality industry. (TN Reading 1, 7, 9; TN Writing 4)

8) Investigate the launch of a new service offered by a hospitality or tourism business, or the opening of a new tourist attraction in the community. For example, review the opening of a new location of a hotel/restaurant chain, or the construction of a new sports or entertainment venue. Research how the company employed the marketing mix to aid in the launch; then create a presentation highlighting successes, challenges, and lessons learned. Additionally, critique the company's strategies and suggest alternative ideas for future campaigns, following the principles of the marketing mix. (TN Reading 1, 4, 9; TN Writing 2, 4, 9)

9) Explain the concept of market segmentation, citing textbooks and case studies in a discussion of how market segmentation is used as a strategy by hospitality and tourism business to increase their market share. Examples may include differentiated pricing of tickets for sporting events or concerts, or different levels of service in lodging or food and beverage businesses. (TN Reading 1, 2, 9; TN Economics 1, 3)

10) Conduct a SWOT analysis on a hospitality and tourism business, identifying its most significant strengths, weaknesses, opportunities, and threats. Highlight the techniques or specific results of market segmentation by including demographic, psychographic, and geographic data in the analysis. (TN Reading 3, 5; TN Writing 4, 7; TN Math N-Q; TN Economics 1, 3)

Marketing Plan

11) Research and analyze the elements of a marketing plan from different businesses in the hospitality and tourism industry. Identify elements commonly found and discuss the concept of return on investment (ROI) as it appears in marketing plans. Cite specific textual evidence from the plans to describe how hospitality businesses measure ROI. (TN Reading 1, 6, 8, 9; TN Writing 8, 9)

12) Create a green or traditional marketing plan for a selected business in the local hospitality industry aimed at increasing the business's visibility to the non-local customer. Outline specific marketing strategies, implementation plans, and evaluation standards. Explain the measures that will be used to quantify the return on investment (ROI). (TN Writing 2, 4, 7)

Promotional Concepts

13) Identify the types of promotion used in the hospitality and tourism industry, such as but not limited to advertising, direct marketing (including social media marketing), sales promotion, personal selling, and public relations. Describe the concept of the promotional mix. Give examples of why all elements of the promotional mix must be coordinated. Identify the major types of advertising media and cite the pros and cons of each. (TN Reading 2, 4; TN Writing 4, 9)

14) Identify and categorize the main benefits of effective promotions and loyalty programs by analyzing journal articles about, each. Research a prominent example of a promotion or loyalty

program; name the company sponsor, identify any nonprofit benefactors, and construct an essay highlighting factors that contributed to the launch of the promotion as well as to its continued existence. Address how social media tools have been leveraged to support the selected example. (TN Reading 1, 2, 6; TN Writing 2, 4, 8, 9)

15) Design a promotion or loyalty plan for a local hospitality business. Include all elements of the promotional mix. Ensure that the plan addresses the following:
    a. Goals
    b. Target market
    c. Message or theme
    d. Coordination aspects
    e. Action plan/implementation
    f. Evaluation instrument
    (TN Writing 4)

16) Describe the concept of standardization as it relates to expansion of hospitality businesses into additional franchises. Describe how a business's image is created and/or enhanced through themes, furnishings, layout, and displays. Conduct site visits comparing and contrasting two businesses in the same hospitality segment, and document with photos, written observations, and/or interviews with personnel. Present findings to the class, assessing the qualities that set each business apart. (TN Reading 2, 7, 9; TN Writing 2, 4, 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity
    o Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.

- ~~TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Hospitality Management

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	5490
Prerequisite(s):	*Hospitality Marketing* (6169)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is the third course in the *Hospitality & Tourism Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Upon completion of the Program of Study, students will be prepared to pursue Certified Hospitality & Tourism Management Professional (CHTMP), and Certified Tourism Ambassador (CTA) certifications.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Description

Hospitality Management is an applied-knowledge course which allows students to continue to develop sound management skills in preparation for future careers in the hospitality industry. Upon completion of this course, proficient students will have skills in management structures and the roles of managers in hospitality-related businesses, with particular attention on the areas of human relations, accounting, sales, professional communications, and legal/ethical considerations and will be equipped with the knowledge and skills to pursue postsecondary study and future employment in the hospitality industry. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

Approved January 30, 2015; Amended April 15, 2016

Program of Study Application

This is the third course in the *Hospitality & Tourism Management* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Hospitality & Tourism website at https://tn.gov/education/article/cte-cluster-hospitality-tourism.

Course Standards

Hospitality Management Structures & Roles

1) Distinguish between a horizontally organized and a vertically organized business or organization in one of the segments of the hospitality industry, drawing information from case studies or textbooks. Create a graphic comparing the two organizational structures, using features such as Smart Art Graphics to show the relationships and roles of each employee/member. Examples of businesses include AAA, the Memphis Grizzlies, Hilton, the Tennessee Titans, and PepsiCo. (TN Reading 1, 2, 5; TN Writing 4, 6, 9)

2) Compare and contrast the four management styles (autocratic, bureaucratic, democratic, and laissez-faire) found in the hospitality industry. Participate in role plays to exhibit characteristics of each type, using hospitality or tourism businesses as examples. Craft an argumentative text in support of the claim that good managers use combinations of these management styles. Cite specific examples from readings to support conclusions. (TN Reading 1, 2, 9; TN Writing 1, 4, 9)

3) Research the management skills required of individuals to be contributing members of a hospitality team (i.e., delegation, motivation, communication, technical skills, time management, organizational planning, and professionalism). Synthesize research to produce a profile of a strong candidate for a hospitality management position in an oral, written, or graphic format. (TN Reading 1, 2, 5; TN Writing 4, 6, 9)

4) Create a list of stressful situations that a manager in one of the hospitality segments may experience in everyday operations. Investigate the potential outcomes and actions of each situation when managed using a certain management style. Craft an explanation of how managerial skills can be applied to address each situation. (TN Reading 1, 9; TN Writing 2, 9)

Human Resources

5) Summarize the major functions of a Human Resources department from the Society of Human Resources Management (SHRM) or similar authority. Prepare an electronic presentation providing an overview of the functions to present to stakeholders or peers. (TN Reading 1, 2; TN Writing 4, 9)

6) Investigate the reporting responsibilities of Human Resources personnel in relation to federal authorities, specifically to the U.S. Social Security Administration (SSA) and Internal Revenue Services (IRS). Compile examples of documents needed by individuals to complete a job application. Obtain copies of documents such as the I-9 Employment Verification Form or W-9 Request for Taxpayer Identification Number and Certification; complete the instructions for filling the documents for submission. (TN Reading 2, 3, 4; TN Writing 4)

7) Synthesize information on the correlation between productivity and employee satisfaction/morale. Create a plan that outlines how to enhance productivity through employee satisfaction. The plan should encourage staff growth and development by recommending methods supported by business and research. (TN Reading 1)

8) Examine authentic vacancy announcements on local and national job boards for positions in the hospitality industry, and assess the typical employment requirements outlined, including certifications, degrees, and years of experience. Create a posting for a select position, including details such as the position title and description, company name, requirements/qualifications, salary conditions, and direction for how to apply. (TN Reading 2, 7; TN Writing 2, 6)

9) Create, review, and revise an electronic Human Resource manual that a hospitality-related business could use to train new hires and staff members. Research major rules and regulations from state and federal agencies such as the Department of Labor and the Equal Employment Opportunity Commission to establish company policies that conform to existing laws. Lay out the document with the following sections, using language, tone, and style appropriate for the intended audience.
   a. Roles and expectations of a position
   b. Compensation
   c. Scheduling
   d. Leave
   e. Social media compliance policy
   f. Handling employee grievances
   g. Addressing customer feedback and complaints
   h. Performance assessments, including performance improvement and rewards
   (TN Reading 9; TN Writing 2, 4, 5, 7, 9)

Accounting

10) Investigate the functions of accounting departments in hospitality-related businesses and organizations. Compare and contrast universal systems of accounts, such as Property Management Systems (PMS) and Point-of-Sales Systems (POS), evaluating the ease of use, cost, and training requirements. Craft an explanation of the advantages and disadvantages of each system by sharing with peers how hospitality businesses use them in their everyday operations. (TN Reading 2, 9; TN Writing 2, 4)

11) Apply financial concepts and terminology to the analysis of hospitality businesses, including but not limited to the following: ledger, financial transaction, account, accounts receivable, accounts payable, audit, posting charges, delinquent quest, profit, and net loss. Demonstrate financial literacy and quantitative reasoning when discussing these concepts in the context of operations; apply basic numeracy skills to understand specific financial operations. (TN Reading 1, 4, 5, 7; TN Math N-Q)

12) Evaluate copies of financial statements (i.e., balance sheet, income statement, profit and loss statement, and cash flow sheet). Interpret the documents to explain how a sample company calculates its cash flow. Apply these skills to prepare a mock financial statement for a hospitality-related service. (TN Reading 3, 4, 5, 7; TN Writing 4, 6; TN Math N-Q)

Sales

13) Compare and contrast the differences between selling a service and selling a product in the hospitality industry. Citing examples from a range of companies or organizations, analyze sales strategies used in the hospitality industry to reach a certain customer demographic. Incorporate the analysis to create a profile of a successful sales professional in a hospitality segment of choice. The profile should include traits relating to professionalism, communication, previous experience, and social skills. (TN Reading 2, 9; TN Writing 2, 4)

14) Select one new product or service provided by a hospitality business of choice. Research the costs associated with providing the new product/service, and examine how the business determined price(s) and promotion strategies. For example, research how a food service establishment expanded its menu or hours of operations, detailing how the business budgeted for added expenses due to labor/facilities and how it priced its products in order to make a profit. Drawing on this research, estimate the expense of adding the new product/service for a related hospitality business; evaluate findings in a mock business presentation, advancing recommendations to the business regarding the return on investment (ROI) of the additional product or service. (TN Reading 9; TN Writing 1, 4, 7)

Professional Communications

15) Write internal and external business correspondence to convey and obtain information effectively for readers. Explain the nature of effective written communications. Select and utilize appropriate formats for professional writing; edit and revise written work consistent with professional standards. (TN Writing 4, 5)

16) Investigate cultural differences when doing business abroad, examining a range of countries and contexts as case studies. Write a memo to staff explaining factors they should consider when doing business in various countries. (TN Reading 2; TN Writing 4)

Legislation & Governing Laws

17) Drawing on research from the Tennessee Department of Labor and Workforce Development, summarize various workers' rights laws and explain how they apply in specific hospitality segments. Craft an essay on the conditions that prompted the laws, the efforts made to enforce the laws, and changes brought about by the laws today. (TN Reading 1, 2, 9; TN Writing 2, 4, 9)

18) Research the seven types of laws that regulate and govern the hospitality industry. Create a report outlining key recommendations and requirements to ensure a workplace free of hazards for all employees, citing sources from the Occupational Safety and Health Administration (OSHA) law and regulations. (TN Reading 1, 2, 4, 9; TN Writing 4, 9)

19) Outline the steps necessary to complete and gain licenses from regulatory agencies such as the Tennessee Department of Commerce and Insurance, Division of Regulatory Boards. Citing evidence from case studies and news media, discuss liability issues that may be problematic if proper licenses are not obtained for projects or events. Example projects or events include but

are not limited to building a structure, organizing a city festival, or implementing smoking ordinances. (TN Reading 1, 2, 4; TN Writing 6)

20) Research the Americans with Disabilities Act (ADA) and other similar resources for suggestions and regulations to accommodate customers with special needs. Create a list citing examples of accommodations that can be found in different environments in the hospitality and tourism industry, such as restaurants, hotels, ships, sporting venues, and theaters. (TN Reading 1, 4, 9; TN Writing 4, 5, 9)

21) Research laws related to consumer protection within the hospitality industry, focusing on the events that influenced their creation. Select one such law and write a narrative essay describing the historical context and the significance of the legislation on customer and business behavior. Examples include guest privacy, total use of room, and protection from personal liability. (TN Reading 1, 4, 6, 8; TN Writing 2, 7, 8)

Ethics

22) Define the concept of ethics in business. Examine case studies of ethical and unethical behavior and discuss the ramifications of those behaviors on both businesses and the public. Create a Code of Ethics for a team of employees as would a manager in a hospitality-related business. (TN Reading 1, 2, 4; TN Writing 4)

23) Research, summarize, and deliver (via presentation, document, spreadsheet data/chart, or other format) a summary of the various perspectives and ramifications surrounding an ethical issue related to a modern-day hospitality business. (TN Reading 1, 2; TN Writing 1, 4, 6, 7)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above

~~should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Event Planning & Management

Primary Career Cluster:	Hospitality & Tourism
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6168
Prerequisite(s):	At least two credits earned in a previous Hospitality & Tourism or Marketing program of study.
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Hospitality & Tourism courses.
Programs of Study and Sequence:	This is a capstone course in the *Hospitality & Tourism Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Certified Hospitality & Tourism Management Professional (CHTMP), Certified Tourism Ambassador (CTA)
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-hospitality-tourism https://tn.gov/education/article/cte-cluster-marketing

Course Description

Event Planning & Management is designed to be a project-based, capstone experience in which students research, prepare, deliver, and reflect upon an original event for a community organization, business, or non-profit. Upon completion of this course, proficient students will further refine leadership, teamwork, and management skills acquired in previous courses and apply them through application in a practicum setting. The course is highly customizable to meet local needs: partner organizations may be chosen at the discretion of student teams, with the approval of the instructor and appropriate school personnel. Organizations can include local non-profits, charities, shelters,

Approved January 30, 2015; Amended April 15, 2016

agencies, businesses, sports teams, school-based enterprises, or other entities with a demonstrated need for assistance in staging an event or a commitment to providing students with work-based learning opportunities. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the capstone course in the *Hospitality & Tourism Management* and *Marketing Management* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Hospitality & Tourism website at https://tn.gov/education/article/cte-cluster-hospitality-tourism, or the Marketing website at https://tn.gov/education/article/cte-cluster-marketing.

Course Standards

Professionalism, Ethics, and 21st Century Skills

1) Search for the resumes of professional event planners or convention managers from the websites of institutions, organizations, or professional networks. Discuss what is typically included in the resumes of event planner professionals, compare and contrast several examples, and create a personal resume modeled after elements identified in the search. ~~(TN Reading 1, 4, 5, 9; TN Writing 4, 8)~~

2) Create and continually update a personal journal to document skills learned during the event planning experience, and draw connections between the experience and previous course content by reflecting on:
   a. Tasks accomplished and activities implemented
   b. Positive and negative aspects of the experience
   c. How challenges were addressed
   d. Team participation in a learning environment
   e. Comparisons and contrasts between classroom and work environments
   f. Interactions with colleagues and supervisors
   g. Personal career development
   h. Personal satisfaction
   ~~(TN Writing 2, 4, 9)~~

Planning Stages

3) Compare and contrast successful strategies used by event planning companies, drawing on profiles of these companies and other evidence from industry magazines, news articles, or textbooks, making note of most beneficial strategies. Evaluate which strategies are appropriate for certain events (i.e., galas, banquets, weddings, etc.). As part of the class project, investigate potential nonprofits or organizations for an event, and collaboratively determine which organization would be appropriate given classroom constraints. Potential clients could include, for example, a local non-profit or community organization. (TN Reading 2, 8, 9; TN Writing 9)

4) Research and select a nonprofit or organization for a project that is need of event planning services. Cite specific textual evidence from the organization's literature, as well as independent news articles to summarize:
    a. The mission and history of the organization
    b. Headquarters and organizational structure
    c. Services provided
    d. Clients/Customers served
    e. Policies and procedures
    f. Reports, newsletters, and other documents published by the organization
    g. Website and contact information
    (TN Reading 1, 2; TN Writing 4, 7)

5) Apply skills and knowledge from previous courses in an authentic classroom-based project. Where appropriate, develop, practice, and demonstrate skills outlined in previous courses. (TN Reading 2, 3)

6) Identify the objective of the event that is to be planned for the nonprofit or other selected organization. Incorporate organization or company interviews into the research. Prepare, review, and revise a written project proposal including the main objective, goals (such as fundraising or attendance), location, criteria, constraints, information obtained through research, and deliverables. (TN Reading 3, 4, 7, 9; TN Writing 2, 5, 7)

7) Collaboratively, develop an evaluation professionalism rubric with performance indicators for each of the following professional attributes and use it to evaluate course assignments and personal work:
    a. Attendance/punctuality
    b. Professional dress and behavior
    c. Positive attitude
    d. Collaboration
    e. Honesty
    f. Respect
    g. Responsibility
    h. Appropriate technology use
    Share the rubric with the client for evaluation purposes as part of the capstone project.

Event Approval & Timetable

8) Research how event planning companies submit proposals to potential clients, and compare and contrast sample proposals in a variety of formats. Determine the central components necessary for any proposal (e.g., a projected budget, maps/diagrams of the event space, personnel involved). Develop an original event proposal, developing claims and recommendations for event logistics based on research and evidence. The proposal should include at minimum the following:
    a. Introduction
    b. Theme of event
    c. Venue
    d. Entertainment
    e. Timeline of planning
    f. Food and Beverage
    g. Appropriate tablewares, linens, and decorations
    h. Budget/cost analysis
    i. Evaluation professionalism rubric
    (TN Reading 2, 3, 6, 9; TN Writing 1, 4)

9) Present the event proposal to the client, asking for feedback and recommendations. Analyze the feedback and recommendations to justify any changes to the event proposal, citing evidence from the initial presentation, and incorporate edits into a formal contract to be executed with the client. Submit the final contract for approval, documenting all changes made. (TN Writing 4, 5)

10) Using the final approved contract, execute the timeline to demonstrate teamwork, problem-solving, and decision-making skills. Work collaboratively to ensure that the needs and expectations of the client are met for the event. In a personal journal, document the capstone experience, drawing on the connections between the project and course content. (TN Writing 4)

11) Compile and interpret the evaluation rubric and feedback from the client, reading the results closely to allow for critical analysis and reflection. Upon conclusion of the capstone project, craft a reflection paper discussing the experience and its impact on career growth. Use technology to showcase highlights, challenges, and lessons learned from the capstone. (TN Writing 2, 5, 6, 7)

12) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge learned in the previous courses and applied in the capstone experience. The portfolio should reflect thoughtful assessment and evaluation of the progression of work. The following documents will reside in the career portfolio:
    a. Career and professional development plan
    b. Resume
    c. List of responsibilities undertaken throughout the course
    d. Examples of visual materials developed and used during the course (such as graphics, drawings, models, presentation slides, videos, and demonstrations)
    e. Event proposal
    f. Final contract

g. Description of technology used, with examples if appropriate
h. Periodic journal entries reflecting on tasks and activities
i. Feedback from instructor and/or supervisor based on observations
(TN Writing 4, 5)

13) Upon completion of the event, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, drawings, and models of project findings, and/or physical artifacts that represent the outcome of the project. Prepare the presentation in a format that could be delivered to both a technical and a non-technical audience. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Early Childhood Education Careers I (ECEC I)

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6015
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the first course in the *Childhood Development Services* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	(050 and 058), (050 and 451), (051 and 058), (051 and 451), (154 and 156), (450 and 058), (450 and 451)
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Early Childhood Education Careers I (ECEC I) is a foundational course in the Human Services career cluster intended to prepare students for careers as childcare providers, nannies, preschool teachers, and more. Course content covers the foundation of childhood development services, careers, provider responsibilities and aptitudes, and fundamentals of child development. Upon completion of this course, students will have created artifacts for inclusion in a course portfolio, which will continue with them throughout the program of study. Standards in this course are aligned with Tennessee State Standards

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the foundational course in the *Childhood Development Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Safety

1) Compile and critique procedures for maintaining a safe and healthy learning environment for children present in a childcare facility. Cite information for the Occupational Safety and Health Administration (OSHA) to identify precautionary guidelines to prevent illness, communicable diseases and injuries. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3; FACS 9)

2) Recognize the signs of child abuse, and research the legal requirements for reporting suspected abuse. Prepare an informative text or presentation describing types of abuse, including signs and symptoms to look for, and outline the reporting requirements and procedures. (TN Writing 4, 7, 9; FACS 12)

Foundations of Childhood Development Services

3) Formulate a hypothesis about the relationship between early childhood education and a student's future success. Gather research from academic journals and news articles and craft an argumentative essay supporting or refuting the hypothesis with specific textual evidence. (TN Reading 1, 8; TN Writing 1, 8)

4) Research and summarize the influences of major educational theorists' philosophies. Evaluate the extent to which the reasoning and evidence presented by the theorists supported their claims. Examples of theorists include:
   a. John Dewey
   b. Maria Montessori
   c. Abraham Maslow
   d. Benjamin Bloom
   (TN Reading 1, 2, 8; TN Writing 2, 7, 8; FACS 4)

5) Cite specific textual evidence to compare and contrast various types of early childhood care services in a graphic organizer, chart, or table. Include information about relevant regulations and licensure requirements. Example programs/providers include, but are not limited to:
   a. Preschool
   b. Nannies
   c. Montessori
   d. Head Start

e. Day care centers
    f. Laboratory schools
    (TN Reading 1, 9; TN Writing 2, 9; FACS 4)

Childhood Development Careers

6) Use local job postings and national labor and workforce data to identify and describe essential knowledge and skills for careers within the childcare field. Complete one or more career interest surveys, analyze the results, and write a summary of the results. Compare the survey results with earlier research findings on essential knowledge and skills for providers. (TN Reading 1, 9; TN Writing 2, 7, 8, 9; FACS 4)

7) Compile and analyze real-time labor market data, including economic and demographic trends, and compare with authentic vacancy announcements on local and national job boards. Use this information to compare and contrast occupations by education requirements, job availability, salaries, and benefits. (TN Writing 8, 9; FACS 4)

Provider Responsibilities and Aptitudes

8) Identify daily tasks of child development service providers through observation, first-hand experience, or online research. Categorize each of the tasks and estimate the time spent on each category of task. Write clear narratives exploring multiple facets of common provider activities, including but not limited to:
    a. Planning effective instruction
    b. Meeting the physical needs of children
    c. Supervising children
    d. Non-instructional activities (such as parent communication, site maintenance, etc.)
    (TN Reading 1, 2; TN Writing 4, 8; FACS 4)

9) Research professional ethical standards from recognized professional organizations, such as the National Association for the Education of Young Children (NAEYC) and the Association for Early Learning Leaders. Synthesize principles from the standards to create a personal code of ethics. (TN Reading 1, 2, 5; TN Writing 4, 8, 9)

10) Describe personal characteristics and aptitudes, including 21st century skills, needed by childcare providers. Create a rubric for self-assessing 21st century skills, such as the ability to:
    a. Communicate verbally and nonverbally in a respectful manner with children, parents, and colleagues
    b. Work effectively in teams and resolve conflicts when necessary
    c. Demonstrate a positive work ethic
    d. Understand different cultural perspectives and their impact in the classroom;
    e. Use instructional technology appropriately
    f. Adapt to changes
    g. Manage time and resources wisely
    (TN Writing 4, 5)

11) Use the self-assessment rubric created during this course to establish a baseline evaluation of 21st century skills, attitudes, and work habits. Working from the baseline, create a growth plan promoting advancement of skills and abilities to place in the career portfolio. (TN Writing 4; FACS 4)

Introduction to Child Development

12) Create an annotated model or graphic illustration to describe the parts and functions of the human brain. Create a brain development timeline from birth through age eight. (TN Reading 3, 7; TN Writing 4, 9; TN Psychology 13, 38; FACS 12)

13) Draw conclusions about the most important influences on and relationships between brain development, reasoning capacity, and learning. Define brain plasticity and describe how it changes over the lifespan. Brain anatomy for research includes: frontal, parietal, occipital, and temporal lobes; brain stem, cerebellum, cerebral cortex, and limbic system. (TN Reading 1, 4, 9; TN Biology I 4; TN Psychology 13, 14; FACS 12)

14) Using relevant information from multiple print and electronic resources, compare and contrast the "ages and stages" identified by influential child development theorists. Formulate a hypothesis about the relationship between child development and how children learn and cite textual evidence to support the hypothesis. Examples of child development theories include, but are not limited to:
    a. Erikson's psychosocial stage theory
    b. Kohlberg's moral understanding stage theory
    c. Piaget's cognitive development stage theory
    d. Bronfenbrenner's ecological systems theory
    (TN Reading 1, 2, 8; TN Writing 1, 4, 8, 9; TN Psychology 35, 38; 43)

15) Analyze the factors that contribute to personality, and investigate several research-based personality assessment tools. Use textual evidence to support the analysis. Reflect on the connections between personality, life experience, environment, and brain development. (TN Reading 1; TN Writing 7; TN Psychology 19, 45, 46, 47; TN Sociology 7, 11; FACS 12)

16) Examine the Tennessee Early Childhood Education Early Learning Developmental Standards. Summarize the major developmental milestones and create a graphic illustrating the continuum of development from birth through age five in these domains:
    a. Speech and Language Development
    b. Early Literacy
    c. Math and Science
    d. Social Studies
    e. Creative Arts
    f. Social and Emotional Development
    g. Physical Development
    (TN Reading 1, 2, 7; TN Writing 2, 4; TN Psychology 38; FACS 4)

17) Research assessment methods used to observe and interpret children's growth and development. Identify risk factors, delays, or disabilities that may indicate a need for special services. (TN Reading 1, 2; TN Psychology 70; FACS 12)

Introduction to Learning

18) Analyze NAEYC's *12 Principles of Child Development and Learning* and additional relevant documents to explain how the principles serve as the foundation for implementing developmentally appropriate practices (DAP) that promote young children's optimal learning. (TN Reading 1, 2, 4; FACS 4)

19) Synthesize academic research to describe and critique major approaches to theories of human learning:
    a. Behaviorism
    b. Cognitive psychology
    c. Social learning theory
    d. Constructivism
    e. Experiential learning
    f. Multiple intelligences
    Write an argumentative essay that develops a claim about how a major educational theory of learning has impacted modern practice of supervising or instructing young children. (TN Reading 1, 4, 6; TN Writing 1, 7, 8, 9; TN Psychology 35, 38, 70)

20) Compare and contrast research on the influence of the following factors on student self-concept and learning:
    a. Student experiences, interests, aptitudes
    b. Family and culture
    c. Teacher/Caregiver behavior and attitudes
    d. Peers
    (TN Reading 1, 2, 9; TN Psychology 47, 55, 66, 70; TN Sociology 11, 15; FACS 12)

Career Portfolio

21) Create a course portfolio, using writing and visual elements to connect personal career preparation artifacts to concepts learned in this course. (TN Writing 2, 4, 6; FACS 4)

22) Synthesize information from Child Development Services career exploration to create a written or electronic career pathway plan that outlines academic and career achievement goals and a timeline for ongoing reflection throughout the program of study coursework.
    a. Identify dual credit courses available within specific programs of study
    b. Gather information from postsecondary institution websites and compare community college, Tennessee Colleges of Applied Technology, and university education programs that align with secondary programs of study
    (TN Reading 7; TN Writing 2, 4, 5, 6, 8; FACS 4)

23) Drawing upon content in this course, write a clear and coherent definition of a *teaching philosophy*, argue its significance to student learning, and create a personal teaching philosophy for inclusion in the professional portfolio. (TN Reading 1; TN Writing 1, 4, 5, 6, 9)

The following artifacts will reside in the student's portfolio:
- Foundations of Human Development artifacts
- Career and Interest Survey artifacts
- Code of Ethics
- 21st Century Skills Rubric
- Brain artifacts and model
- Child Development Theorist research
- Tennessee Early Childhood Education Early Learning Development Standard artifact
- Human Development narrative
- Career Cluster Pathway Plan artifact
- Personal Teaching Philosophy

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Biology I: Tennessee Science: Biology I standard 4 may provide additional insight and activities for educators.
- TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.
- TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, [FACS](#).
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Early Childhood Education Careers II (ECEC II)

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6016
Prerequisite(s):	*Fundamentals of Education* (6123) or *Early Childhood Education Careers I* (6015)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Education and Training or Human Services courses.
Programs of Study and Sequence:	This is the second course in both the *Early Childhood Education* and *Childhood Development Services* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	(050 and 058), (050 and 451), (051 and 058), (051 and 451), (154 and 156), (450 and 058), (450 and 451)
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Early Childhood Education Careers II (ECEC II) is an intermediate course for students interested in learning more about becoming an early childhood teacher, nanny, or childcare provider. This course covers the components of curriculum planning, learning, screening and assessing, special populations, and educational technology. Students will observe educators in action, practice specific skills, and add personal work products to a course portfolio. Upon completion of this course, proficient students will be

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able to pursue more advanced coursework in the ECEC program of study. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards for Psychology and Sociology, as well as the National Standards for Family and Consumer Sciences Education, Second Edition.*

Program of Study Application

This is the second course in the *Early Childhood Education* and *Childhood Development Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the respective career cluster websites at https://tn.gov/education/article/cte-cluster-education-training and https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Safety

1) Compile and critique procedures for maintaining a safe and healthy learning environment for children present in a childcare facility. Cite information for the Occupational Safety and Health Administration (OSHA) to identify precautionary guidelines to prevent illness, communicable diseases and injuries. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3; FACS 9)

2) Recognize the signs of child abuse, and research the legal requirements for reporting suspected abuse. Prepare an informative text or presentation describing types of abuse, including signs and symptoms to look for, and outline the reporting requirements and procedures. (TN Writing 4, 7, 9; FACS 12)

Curriculum or Activity Planning

3) Research and analyze informational texts to identify components of developmentally appropriate instruction for children from birth through age eight. Compare and contrast components of curriculum planning models, including but not limited to the following:
    a. Bank Street developmental-interaction approach
    b. Dodge creative curriculum for preschool
    c. High/Scope curriculum
    d. Kamii-DeVries constructivist approach
    e. Montessori method
    f. Direct instruction mode.
    (TN Reading 4, 6, 9; TN Writing 8, 9; FACS 4)

4) Create an annotated graphic illustrating the stages of human development from birth through age eight and the corresponding activities that support physical, emotional, social, and intellectual development at each stage. (TN Reading 1, 7, 9; TN Writing 2, 8, 9; TN Psychology 36, 38, 41, 42, 43, 44; FACS 4, 12)

5) Research the characteristics of the stages of play development. Draw conclusions about the relationship between play and child development and learning. Synthesize the research to write

recommendations for developmentally appropriate time, structure, materials, and equipment for play within an early childhood care program. (TN Reading 2, 5; TN Writing 1, 7, 9; TN Psychology 33)

6) Citing specific textual evidence found in academic journals or research, defend the need for the preparation of a comprehensive curriculum for children from birth through age eight. Address the developmental significance of including the following in a curriculum:
   a. Music
   b. Art
   c. Role-play/Pretend Play
   d. Reading
   e. Storytelling
   f. Outdoor excursions
   g. Games
   (TN Reading 1; TN Writing 1; TN Psychology 42, 43; FACS 4)

Learning

7) Using academic journals and news articles, investigate how social, cultural, and economic factors inside and outside of the classroom influence student learning and student behavior. Assess the extent to which reasoning and evidence support the author's claim, citing specific textual evidence. (TN Reading 1, 8; TN Psychology 46, 47, 55, 56; TN Sociology 12, 13, 22; FACS 4, 12)

8) Compare and contrast a range of learning styles identified in relevant education research. Synthesize information about the characteristics of each learning style, such as examples of teaching methods, and assignments in an informative text, graphic organizer, or other illustration. Learning styles include:
   a. Visual/Spatial Learners
   b. Auditory/Verbal/Linguistic Learners
   c. Analytic Learners
   d. Kinesthetic or Tactile Learners
   e. Global Learners
   (TN Reading 2, TN Psychology 26, 35; FACS 4, 12)

Screening and Assessment

9) Differentiate between child screening, assessment, and evaluation. Collect firsthand data through interviews with local child care providers to identify the most common assessment processes used. Citing specific textual evidence, describe the purpose and procedures associated with common types of assessments, including:
   a. Continuous
   b. Developmental
   c. Diagnostic
   d. Family
   e. Multidisciplinary
   f. Play-based
   g. Readiness

10) Prepare a narrative to demonstrate understanding of the role of the provider in screening infants and children. Create a checklist of simple activities that a provider can use with children from birth to age eight to screen for achievement of significant developmental milestones. (TN Reading 1; TN Writing 2, 4)

11) Compare and contrast the instruments currently available to assess what children know, understand, and are able to do within the physical, social, emotional, and cognitive development domains. Assessment instruments include but are not limited to the:
    a. Ages and Stages Questionnaire
    b. Battelle Developmental Inventory Screening Test
    c. Birth to Three Assessment and Intervention System
    d. Checklist for Autism in Toddlers
    e. Denver Developmental Screening II
    f. Devereux Early Childhood Assessment
    g. Parents Evaluation of Developmental Status (PEDS) test
    h. Temperament and Atypical Behavior Scale
    (TN Reading 9; FACS 12)

Special Populations

12) Research the Individuals with Disabilities Education Act (IDEA), Section 504 of the Rehabilitation Act of 1973 and Americans with Disabilities Act (ADA). Summarize the broad categories that IDEA identifies as disabilities and describe general eligibility requirements. Write an analysis of the impact of this legislation on the education of students with special needs. (TN Reading 1, 2; TN Writing 2, 4, 7, 9; TN Psychology 70)

13) Investigate the roles of parents, teachers, and administrators at an Admission, Review and Dismissal (ARD) meeting and create a visual representation of the ARD process. Examine examples of authentic individualized education programs (IEPs) designed to address the needs of children with disabilities and analyze how the required adaptations and accommodations vary from standard developmentally appropriate practices. (TN Reading 2, 3, 7; TN Writing 2, 4, 7, 9; TN Psychology 70)

14) Draw evidence from informational texts to define special populations and write a narrative describing the characteristics of special needs children and accommodations recommended for those who have:
    a. Intellectual and developmental disabilities
    b. Emotional or behavioral disorders
    c. Communications disorders, deafness, and hearing loss
    d. Blindness and low vision
    e. Physical disabilities
    f. Gifted and talented designation
    (TN Reading 1, 4; TN Writing 2, 4, 9; TN Psychology 70)

Educational Technology

15) Drawing evidence from research, develop a logical argument to support how technology can enhance or inhibit the development and learning processes of children from birth to age eight. Create a graphic illustrating developmentally appropriate technology through the ages and stages. (TN Reading 1; TN Writing 1, 4, 7, 9)

16) Research the Children's Internet Protection Act (CIPA) from the Federal Communication Commission (FCC) and other informational texts on internet safety for students. Synthesize the research to create acceptable-use policies for students that are appropriate at different developmental milestones. (TN Reading 2; TN Writing 2, 4, 7, 9)

Final Project

17) Create a checklist or rubric synthesizing concepts learned in ECEC I and ECEC II to use as a classroom observation tool. Perform guided observations at the preschool and elementary levels to identify characteristics of an effective classroom and teacher. Write an essay reflecting on the observation experience and revise written career goals and a personal teaching philosophy (developed in ECEC I). Update the print or electronic portfolio, including writing and visual elements to connect observations from the final project to concepts learned in this course. (TN Writing 2, 4, 5, 6, 7)

The following artifacts will reside in the student's portfolio:
- Revised career pathway plan and timeline for achieving academic and career goals
- Revised personal teaching philosophy
- Reflection essay based on observations from the final project

Standards Alignment Notes

*References to other standards include:
- TN Reading: ; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Psychology: Tennessee Social Studies: standards may provide additional insight and activities for educators.
- TN Sociology: Tennessee Social Studies: standards may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Early Childhood Education Careers III (ECEC III)

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6017
Prerequisite(s):	*Early Childhood Education Careers II* (6016)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the third course in the *Childhood Development Services* program of study.
Aligned Student Organization(s):	Family, Career, and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Child Development Associate (CDA), and Tennessee Early Childhood Training Alliance (TECTA) certification
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	(050 and 058), (050 and 451), (051 and 058), (051 and 451), (154 and 156), (450 and 058), (450 and 451)
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Early Childhood Education Careers III (ECEC III) is an applied-knowledge course for students interested in becoming an early childhood teacher, nanny, or childcare provider. This course covers the components of the learning environment, planning age appropriate activities, using activities for learning, and developing communication skills. If available, students may participate in a work-based learning

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component of instruction and add work products to a course portfolio. Upon completion of this course, proficient students will be prepared to participate in the capstone *ECEC IV* course and/or continue their studies at the postsecondary level. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards for Psychology and Sociology, as well as the National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Work-Based Learning Framework

Standards outlined below may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the third course in the *Childhood Development Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Safety

1) Compile and critique procedures for maintaining a safe and healthy learning environment for children present in a childcare facility. Cite information for the Occupational Safety and Health Administration (OSHA) to identify precautionary guidelines to prevent illness, communicable diseases and injuries. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3; FACS 9)~~

2) Recognize the signs of child abuse, and research the legal requirements for reporting suspected abuse. Prepare an informative text or presentation describing types of abuse, including signs and symptoms to look for, and outline the reporting requirements and procedures. ~~(TN Writing 4, 7, 9; FACS 12)~~

Managing the Care Environment

3) Drawing on evidence from informational texts, create a rubric for evaluating the establishment of a positive early childhood environment, including indicators such as visual appearance of the environment, playground equipment safety, child engagement, and provider interaction with children and their parents/guardians. ~~(TN Reading 1; TN Writing 2, 7; FACS 4)~~

4) Interview educators to review the results of a site's most recent evaluation under current state regulations, which rates child care facilities based on:
   a. Director qualifications (for child care centers)
   b. Professional development
   c. Developmental learning
   d. Parent/family involvement
   e. Ratio and group size (for child care centers)
   f. Business managements (for family and group child care homes)
   g. Staff compensation (for child care centers)
   h. Program assessment
   (TN Reading 1; TN Writing 2, 9)

5) Research the correlation between physical layout (including the use of learning centers for a variety of activities) and effective care environment management. Compare the use of furniture and space in several environments and analyze their compliance with research-based recommendations for layout and with specified legal requirements, including health and safety guidelines. (TN Reading 1, 8, 9; TN Writing 2, 4, 7, 9; FACS 4)

6) Interview educators and/or providers and create a checklist for performing classroom procedures and for responding to emergency situations, including but not limited to recognizing possible child welfare issues, following fire drills and other natural disaster protocols, and responding to intruder alerts. (TN Writing 2, 4, 7)

7) Research common reasons for misbehavior in children aged two to eight and cite evidence to support development of a written behavior policy to share with parents. From this information, create a graphic illustration demonstrating expected positive behaviors and the appropriate rewards/consequences for use with children to guide behavior at each age level. (TN Reading 1, 2, 7; TN Writing 2, 4, 7, 9; FACS 4)

8) Citing specific textual evidence from research on the developmental stages of children, plan and implement (as part of the final project) a schedule for each age from birth to age eight that incorporates the appropriate amounts of physical activity and quiet time; individual, small group, and large group experiences; and child-initiated and adult-led activities. (TN Reading 1, 3, 4; FACS 4)

9) Discuss and illustrate modifications to the physical environment to accommodate students with disabilities. (TN Reading 2, 7; TN Psychology 70)

Caring for Young Children

10) Research and synthesize informational texts to determine the characteristics of communicable childhood diseases. Compare and contrast via a table, chart, or graphic annotated with:
   a. Name
   b. Disease Symptoms
   c. Transmission methods
   d. Incubation period
   e. Prevention strategies
   f. Required immunizations (Tennessee Department of Health Rule 1200-14-1-.29)

g. Decision tree or flow chart for admitting sick child
(TN Reading 1, 7; TN Writing 2, 4, 9, FACS 4)

11) Identify, practice, and demonstrate appropriate procedures for meeting developmentally appropriate physical needs of children, including but not limited to:
   a. Hygiene
   b. Rest
   c. Safety
   d. Hydration and nutrition
   e. Appropriate dress
   f. First-aid and CPR
   (TN Reading 2, 3)

12) Analyze case studies of provider reactions to children in specific challenging situations. Write a narrative describing the consequences of these behaviors and comparing them to the personal code of ethics developed in ECEC I. (TN Reading 2, 6, 8, 9; TN Writing 2, 5, 9)

Planning Developmentally Appropriate Learning Activities

13) Drawing evidence from academic research, create a rubric for evaluating and selecting developmentally appropriate books, materials, toys, and technology resources by age. Examples of criteria to be analyzed include but are not limited to:
   a. Age and developmental level
   b. Safety
   c. Visual and tactile appeal
   d. Promotion of learning through play, exploration, or interaction
   e. Adaptability for differently-abled children
   f. Durability
   g. Non-stereotyped representation of groups from different cultures or ethnic backgrounds
   (TN Reading 1, 4; TN Writing 4, 6, 9; Psychology 33, 38; Sociology 7, 9; FACS 4, 12)

14) Conduct a short research project on lesson planning for multiple developmental levels. Demonstrate knowledge of the relationship between subject areas (such as music, language, etc.) to stimulate growth in specific developmental domains. Describe the typical components of lesson planning documents and create a template that incorporates components such as:
   a. Learner developmental level/age
   b. Developmental domains addressed
   c. Subject area
   d. Materials and equipment needed
   e. Learner grouping (one-on-one, small group, large group)
   f. Instructional activities
   g. Schedule (daily, weekly, monthly)
   h. Accommodations for special needs students
   i. Closure/reflection
   j. Assessment
   (TN Reading 2, 5; TN Writing 4, 7, 8, 9; Psychology 33, 38; FACS 4)

15) Create and perform activities to screen for achievement of significant developmental milestones with children from birth to age eight, using the checklist of simple activities created in ECEC II. Write recommendations for working with parents when a developmental delay is suspected. (TN Writing 1, 4; TN Psychology 70; FACS 4, 12)

16) Using instructional materials and academic research, analyze individual and group teaching strategies. Create a graphic illustration citing appropriate evidence to support those strategies that most effectively promote learning. (TN Reading 1, 2; TN Writing 1, 8, 9)

Communication Skills (21st Century Skills)

17) Identify best practices for encouraging parental involvement and write clear and coherent instructions for informing parents about the educational philosophy of the center, goals for the child's development, instructional approach, and desire for ongoing communication about the parent-provider education partnership. (TN Reading 1, 2; TN Writing 4)

18) Demonstrate effective communication and interaction with children, including but not limited to:
   a. Active listening
   b. Open-ended questioning
   c. One-on-one conversations
   d. Group discussions (e.g., circle time)
   e. Modeling appropriate grammar and vocabulary for the context
   f. Acknowledging and addressing emotions
   (TN Reading 2, 4; TN Writing 4; FACS 13)

Final Project

19) Apply knowledge from this course and document the final project in the course portfolio. Demonstration of knowledge includes but is not limited to:
   a. Performing simple activities to check developmental milestone attainment
   b. Maintaining children's records
   c. Using a lesson plan template to create daily activities (created in this course) and implement them with small groups, using developmentally-appropriate teaching strategies
   d. Arranging learning centers that provide for children's exploration, discovery, and development
   e. Selecting and using multiple resources and teaching methods
   f. Creating a classroom floor plan designed to provide equitable access and maximize learning for all students
   g. Evaluating student levels to adapt lessons for differentiated instruction, as needed
   h. Establishing of a positive classroom climate
   i. Creating opportunities for positive communication with families

The following artifacts will reside in the student's portfolio:
- Early Childhood Environment Rubric
- Health and Safety document
- Classroom Procedure Checklist

- Communicable Disease artifacts
- Developmentally Appropriate Learning Rubric
- Teaching Strategies graphic
- Communication artifacts
- Behavior Graphic illustration
- Revised Career and Professional Growth Plan
- Sample Child's Work

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Psychology: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Psychology 9-12.~~
- ~~TN Sociology: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Sociology 9-12.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Early Childhood Education Careers IV (ECEC IV)

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6135
Prerequisite(s):	*Early Childhood Education Careers III* (6017)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus if taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the capstone course in the *Childhood Development Services* program of study.
Aligned Student Organization(s):	Family, Career, and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Child Development Associate (CDA), and Tennessee Early Childhood Training Alliance (TECTA) certification
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	(050 and 058), (050 and 451), (051 and 058), (051 and 451), (154 and 156), (450 and 058), (450 and 451)
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Early Childhood Education Careers IV (ECEC IV) is capstone course for students who intend to pursue advanced training as an early childhood teacher, nanny, or childcare provider. The course standards cover understanding of the components of professionalism, policies, regulations, and teaching and learning. Students will participate in a work-based learning component of instruction and add work products to a course portfolio. Upon completion of this course, proficient students will be prepared to continue their studies at the postsecondary level. Standards in this course are aligned with Tennessee

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Work-Based Learning Framework

Internship standards outlined below may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the capstone course in the *Childhood Development Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Safety

1) Compile and critique procedures for maintaining a safe and healthy learning environment for children present in a childcare facility. Cite information for the Occupational Safety and Health Administration (OSHA) to identify precautionary guidelines to prevent illness, communicable diseases and injuries. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3; FACS 9)

2) Recognize the signs of child abuse, and research the legal requirements for reporting suspected abuse. Prepare an informative text or presentation describing types of abuse, including signs and symptoms to look for, and outline the reporting requirements and procedures. (TN Writing 4, 7, 9; FACS 12)

Professionalism and 21st Century Skills

3) Add the following professional attributes to the professionalism rubric created in ECEC I and write performance indicators for each:
   a. Attendance/punctuality
   b. Professional dress and behavior
   c. Positive attitude
   d. Collaboration
   e. Honesty
   f. Respect
   g. Responsibility

h. Appropriate technology use
i. Reflective teaching practice.
(TN Writing 4, 5; FACS 14)

4) Interview internship supervisor to determine the child care *program philosophy*. Research and gather diverse program philosophies from a variety of care situations and write a narrative comparing and contrasting them with the internship program philosophy. (TN Reading 6, 9; TN Writing 2, 8, 9)

5) Analyze case studies of provider reactions to children in both positive and negative situations. Write a narrative describing the consequences of provider behaviors and comparing them to the personal code of ethics developed in ECEC I. (TN Reading 2, 6, 9; TN Writing 2, 4, 9)

6) Research codes of ethics for running small businesses by comparing samples from professional organizations (such as the Society for Human Resource Management). Synthesize principles from the codes to add attributes and performance indicators to the personal code of ethics created in ECEC I. This document will be included in course portfolio. (TN Reading 9; TN Writing 4, 5, 9)

Policies

7) Access electronic resources related to the Tennessee Licensure Rules for Child Care Centers to identify the provider regulations for licensure and operation. Summarize the requirements and create tracking tools for documenting legal compliance. Topics for investigation include, but are not limited to:
   a. Application for and maintenance of licensure
   b. Ownership and organizational structure
   c. Insurance
   d. Required parental communication
   e. Record keeping
   f. Adult-child ratios
   g. Indoor and outdoor play equipment
   h. Educational activities
   i. Technology use
   j. Health and safety
(TN Reading 2, 7; TN Writing 4, 6)

8) Research and cite the procedure for documenting and reporting child welfare concerns. Analyze a case study and assess the extent to which the proposed resolution of the case is appropriate. (TN Reading 1, 6, 8; TN Writing 9; FACS 4)

9) Drawing upon state regulations, develop procedures for releasing children (such as list of authorized persons; photo ID) and create parent documentation forms for medical information (such as food allergies, known disabilities, permission to administer medicine) and emergency contact information. (TN Reading 2, TN Writing 4, 6; FACS 4)

Requirements for Child Care Careers

10) Gather relevant information from multiple print and digital resources (such as job postings and promotional materials) to prepare a document or graphic comparing the entry-level qualifications for caregivers, assistant directors, and directors of child care centers. Evaluate the impact of postsecondary training and describe the benefits of participation in a professional early childhood organization, such as the National Association for the Education of Young Children (NAEYC). Revise the career pathway plan outlining academic and career achievement goals and timeline developed in ECEC I to reflect opportunities for advancement in the field. (TN Reading 2, 9; TN Writing 4, 5, 8, 9; FACS 4)

11) Review case studies in education to argue the need for background checks—fingerprinting, drug testing, and checking professional references—and a professional code of conduct for providers and volunteers. (TN Reading 8; TN Writing 1)

12) Working in teams, use resources such as those available from the U.S. Small Business Administration to identify the components of a business plan. Create a hypothetical child care center and write a description of the business, its mission statement and an analysis of the market for its services. (TN Reading 2; TN Writing 4; FACS 4)

Teaching and Learning

13) Use a lesson plan template (created in ECEC III) to create daily activities within themed units of instruction for implementation with children ages one to eight. Where appropriate, align the activities with NAEYC's effective developmentally appropriate teaching strategies:
   a. Acknowledge what children do or say
   b. Encourage persistence and effort
   c. Give specific feedback rather than general comments
   d. Model attitudes, problem-solving, and behavior toward others
   e. Demonstrate the correct way to do something
   f. Add challenges that promote cognitive development
   g. Ask questions that provoke children's thinking
   h. Give assistance (such as cues or hints)
   i. Provide information directly
   j. Give directions for children's action or behavior
   (TN Writing 4, 5, 9; FACS 4, 12)

14) Use the rubric (created in ECEC III) for evaluating and selecting developmentally appropriate books, materials, toys, and technology resources.

15) Create developmentally appropriate, visually appealing instructional materials and resources, as well as electronic media (if available), to accompany lesson facilitation during the internship. (TN Writing 4, 6; FACS 4)

16) Develop a communication rubric with performance indicators for effective verbal, non-verbal, written, and electronic communication. Create a draft agenda for parent conferences. Use the rubric to evaluate simulated parent conferences (prior to internship). (TN Writing 4; FACS 13)

17) Research language acquisition and use by children from ages one to eight, using academic journals and case studies. Write a narrative to demonstrate understanding of teaching strategies that promote development of complex language skills. ~~(TN Reading 4, 9; TN Writing 1, 4; FACS 4, 12)~~

18) Draw evidence from informational texts to develop lesson activity adaptations for inclusion of children with fine motor, gross motor, cognitive, social/emotional, and self-help/adaptive special needs. ~~(TN Reading 2, 5, 9; TN Writing 4, 7, 9; TN Psychology 38, 70; FACS 4, 12)~~

Internship

19) Apply knowledge from this and preceding ECEC courses to document the internship in the course portfolio. Demonstration of knowledge includes but is not limited to:
    a. Performing simple activities to check developmental milestone attainment
    b. Maintaining children's records
    c. Using a lesson plan template to create daily activities within themed units of instruction for implementation with children ages one to eight using developmentally-appropriate teaching strategies
    d. Using the behavior management chart (created in ECE III)
    e. Arranging learning centers that provide for children's exploration, discovery, and development
    f. Selecting and using multiple resources and teaching methods
    g. Creating new instructional materials
    h. Creating a classroom floor plan designed to provide equitable access and maximize learning for all students
    i. Evaluating student levels to adapt lessons for differentiated instruction, as needed
    j. Establishing of a positive classroom climate
    k. Creating opportunities for positive communication with families
    ~~(TN Writing 4, 5, 6, 9)~~

20) Collaboratively, create a rubric that will be used by observers to evaluate preparation for the internship, implementation of lesson plans, and professionalism. ~~(TN Writing 4)~~

21) During the internship, implement lesson plans developed in this course and carry out daily childcare routines, such as meals, naps, personal hygiene and exercise. Annotate lesson plans and work products to document lessons learned. ~~(TN Writing 5)~~

22) Create and continually update a personal journal to document the internship. Draw connections between the experience and course content, thoughtfully reflecting on:
    a. Tasks accomplished and activities implemented
    b. Lesson effectiveness
    c. Positive and negative aspects of the experience
    d. Self-assessment and plans for refining instructional practice
    e. Interactions with children, families, providers and other staff
    f. Personal satisfaction
    ~~(TN Writing 4, 7, 10; FACS 4)~~

23) Upon conclusion of the internship, write a clear and coherent reflection paper containing a revised personal teaching philosophy and career growth plan based on the teaching journal. Produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the internship. (TN Writing 2, 5, 6, 7; FACS 4)

The following artifacts will reside in the student's portfolio:
- Revised professionalism rubric
- Revised statement of personal teaching philosophy
- Revised personal code of professional ethics
- Revised career and professional growth plan
- A description of the internship setting, children, and a contract or list of interning student responsibilities
- Lesson plans, assignments, developmental assessment activities and instructional materials created
- Examples of visual material incorporated (e.g. graphics, presentation slides, videos, demonstrations) into lessons
- Description of instructional technology used, with examples if appropriate
- Daily teaching journal reflecting on tasks and activities, lesson effectiveness, positive and negative aspects of the experience, self-assessment, plans for refining instructional practice, and interactions with students, families, teachers and staff
- Feedback from supervising teacher at site and from ECEC IV teacher based on observations
- Sample child's work product

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.
- TN Psychology: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Psychology 9-12.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Human Studies

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6137
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the first course in both the *Dietetics & Nutrition* and *Social Health Services* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit or dual enrollment opportunities for this course. If interested in establishing, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Introduction to Human Studies is a foundational course for students interested in becoming a public advocate, social worker, dietician, nutritionist, counselor, or community volunteer. Upon completion of this course, a proficient student will have an understanding of human needs, overview of social services, career investigation, mental health, and communication. Artifacts will be created for inclusion in a portfolio, which will continue to build throughout the program of study. Standards in this course are aligned with Tennessee State Standards for English Language & Literacy in Technical Subjects, as well as

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is the introductory course in both the *Social Health Services* and *Dietetics and Nutrition* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Human Needs

1) Describe the different levels of human growth (using research such as Maslow's hierarchy of needs) and articulate the different characteristics of each level. Make a graphic that illustrates the pattern of metamotivation as humans fulfill each type of needs. (TN Reading 2, 5, 7; FACS 12)

2) Evaluate factors that impact human growth and physical development in areas related to personality development, temperament, self-understanding, and interpersonal relationships with family and peers. Make a chart/informational graphic of how each of these factors contributes to building healthy relationships and their role of self-actualization in human development. (TN Reading 2, 5, 7; TN Psychology 33, 38, 60; TN Sociology 25; FACS 12, 13)

3) Research the development of self-esteem and self-image in individuals. Create a list of factors that promote and hinder the development of positive self-esteem and self-image. Formulate a plan to build/improve self-esteem in a class project or school based project. (TN Reading 2, 5; TN Psychology 46; TN Sociology 25; FACS 12)

4) Cite specific textual evidence from the U.S. Food and Drug Administration and U.S. Department of Health and Human Services to analyze necessary dietary practices and specific recommendations for physical health, including dietary guidelines and meal plans. Research the importance of balanced nutrition on human development and productivity, and the correlation to mental health and wellness. (TN Reading 1, 2; TN Writing 2, 7, 9; FACS 14)

5) Compile and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government-published fact sheets. Review general common laboratory safety procedures, including but not limited to prevention and control procedures. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3; FACS 9)

6) Research the management skills required of individuals in order to be productive members of society. Identify the specific skills related to time management, organizational planning, and professionalism necessary for success in diverse environments such as the workplace, and apply concepts learned to produce specific recommendations in a written or graphic format. (TN Reading 2, 5; TN Writing 4; FACS 12)

Overview of Human & Social Services

7) Research and summarize the influence of significant contributors to the history and development of counseling, human services and dietetics fields. Create a timeline that shows when each of these major figures lived and worked. Major figures include, but are not limited to:
   a. Anna Y. Reed and Eli Weaver
   b. Ellen Richards
   c. Doris Calloway
   d. James Lind
   e. James Cattell
   f. E. G. Williamson
   g. Carl Pfeiffer
   (TN Reading 2, 7; TN Writing 2, 6)

8) Research and analyze the ecological factors that inhibit optimal social, emotional, and physical well-being of individuals. Create a graphic that illustrates the connections between the environment and the physical or mental well-being of individuals, citing examples from local or state health agencies. (TN Reading 1, 6; TN Writing 7, 9; TN Psychology 19, 38; FACS 12)

Career Investigation

9) Compile and analyze real-time labor market data, including economic and demographic trends, and compare with authentic vacancy announcements on local and national job boards. Use this information to compare and contrast occupations by education requirements, job availability, salaries, and benefits. Outline an educational pathway to obtain the necessary level of education for a chosen occupation. (TN Reading 2, 8, 9)

10) Examine licensing, certification, and credentialing requirements for specific counseling careers within human services (careers include counseling, social services, and dieticians) at the national, state, and local levels to maintain compliance with industry requirements. List the requirements to obtain the credentials and what one must do to maintain the credential. (TN Reading 9; TN Writing 2; FACS 7)

11) Examine requirements for career advancement to plan for continuing education and training. Research professional development opportunities needed to keep current on relevant trends and information within the cluster. Example careers include social worker, marriage and family therapists, health educators, and mental health counselors. (TN Reading 2, 7; TN Writing 2, 6; FACS 7)

Mental Health

12) Research theories of mental health and create a graphic illustration or presentation summarizing the findings. Illustrations and presentations should include: key people in the development of the theory, main points of the theory, and assessment of the extent to which reasoning and evidence support the theory. Theories to research include, but are not limited to:
   a. Developmental Theory
   b. Behavioral Theory

c. Cognitive-Behavioral Theory
(TN Reading 8; TN Writing 2, 6; TN Psychology 35, 38; FACS 7, 12)

13) Investigate the physiological effects of stress and crisis using research from the National Institute of Mental Health. Synthesize the information to identify the types of crises and create a graphic illustration of appropriate responses, management strategies, and technology available to meet individual and family needs during crisis situations. (TN Reading 1; TN Writing 9; FACS 12, 13)

14) Using investigative research, prepare a presentation or informative essay that explains the coping methods for individuals suffering from disorders, stress, or traumatic events. (TN Reading 1; TN Writing 9; FACS 12, 13)

15) Write a research paper or conduct a project on a current mental and social health issue using appropriate digital search resources and academic writing. Topics might include but are not limited to:
a. Teenage Pregnancy
b. Peer Pressure
c. Substance abuse
d. Bullying/Cyberbullying
e. Eating disorders/Emotional eating
(TN Reading 1; TN Writing 2, 8, 9; TN Psychology 45, 46, 47, 66)

Communication Skills

16) Develop and practice active listening skills including: identification of speaker's major points, focusing on speaker's message rather than listener's response, discriminating between fact and opinion, and verifying interpretation of message. Use appropriate note taking techniques and overcome communication barriers by treating the speaker with courtesy and respect. Seek clarity of reception of communication by responding to verbal messages and other cues such as body language by rephrasing statements and asking questions. (TN Reading 3; TN Sociology 13, 14; FACS 13)

17) Compare and contrast skills for communicating professionally as well as informally in everyday social interactions. Differentiate between verbal and nonverbal communication. List specific techniques for effective communication and evaluate how different cultures attach different meanings to communication techniques. (TN Reading 4, 9; TN Writing 4; TN Sociology 9, 13, 14)

18) Practice communication skills by participating in role-play exercises and critiquing the role-play exercises of others. Demonstrate specific techniques for building rapport with the client or others. (TN Reading 3)

The following artifacts will reside in the student's portfolio:
o Human Needs artifacts
o Management Resources recommendations
o Career Fact artifact
o Occupation graphic
o Summary of Theories of Mental Health artifact

- o   Stress & Crisis Informational resource
- o   Communication Skills artifacts

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - o   Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3, 5, 6, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - o   Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.
- TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.
- TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o   Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Lifespan Development

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6013
Prerequisite(s):	None
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the second course in the *Social Health Services* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Lifespan Development builds basic knowledge in human growth and development. Upon completion of the course, proficient students will have knowledge of developmental theory, principles of growth, behavior of children from conception through adolescence, adult development and aging, and death and dying. Artifacts will be created for inclusion in a portfolio, which will continue to build throughout the program of study. Standards in the course are aligned with Tennessee State Standards for English

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Program of Study Application

This is the second course in the *Social Health Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Foundations of Human Development

1) Differentiate between the major methodologies used in research on human growth and development. Compare and contrast the benefits and consequences of each, including ethical issues involved with each method. Methods should include the following:
    a. Case study method
    b. Social survey method
    c. Naturalistic observation method
    d. Cross-cultural studies
    (TN Reading 1, 2, 7; TN Psychology 35; FACS 12)

2) Using supporting evidence from a variety of academic journals and news media, compare and contrast the following theories of human development. Identify the researcher(s) credited with developing each theory and analyze the significance of their contributions to the field of human development.
    a. Psychoanalytic theories
    b. Behavioral theories
    c. Humanistic theories
    d. Cognitive theories
    e. Ecological theory
    f. Sociocultural Theory
    (TN Reading 1, 2, 6; TN Psychology 35, 38; FACS 12)

3) Conduct a research project on a topic related to human growth and development, citing specific textual evidence from academic resources. Topics might include, but are not limited to:
    a. Emotional development/emotional intelligence
    b. Cross-cultural conceptions of intelligence
    c. Self-esteem
    d. Relationships
    e. Nature vs. nurture
    f. Temperament and personality
    (TN Reading 1, 2, 4, 9; TN Writing 2, 7, 8, 9; TN Psychology 19, 33, 36, 38, 45, 46, 55, 60; TN Sociology 11, 21, 25; FACS 12)

Prenatal Development

4) Outline the biological processes that occur from conception to delivery of a full-term infant, sequenced by trimester. Prepare an informational artifact for parents that describe each stage of growth and development. Analyzing the role of heredity and environment in infant growth and development. Create a corresponding list of common risk factors during each stage. (TN Reading 1, 2, 4; TN Writing 4, 6, 7, 8, 9; TN Psychology 19, 36, 39; FACS 12)

5) Define the concepts of DNA, genes, genetics, heredity, and analyze the structure of relationships among the concepts. Describe the process of how traits are passed from parents to offspring. Identify the most common chromosomal and gene-linked anomalies and the health implications associated with each. (TN Reading 1, 2, 4, 5; TN Writing 4, 7; TN Psychology 19, 39; FACS 12)

6) Research the various types of labor and delivery. Create a sequenced presentation, artifact, or graphic describing what happens at each stage and complications that may arise, citing evidence from case studies and medical literature. Investigate what medical testing that the newborn might undergo over the course of the first few days of life. Newborn testing examples include but not limited to:
   a. Apgar score
   b. Brazelton Neonatal Behavioral Assessment Scale
   c. Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS)
   (TN Reading 1, 2, 7, 8; TN Writing 2, 4, 7; FACS 12)

Infancy

7) Research and outline the physical, cognitive, and emotional-social development that occurs during infancy. Prepare an informational artifact for parents that describes this stage of growth and development with real life examples including but not limited to the following:
   a. Physical: head and skull, interpreting height and weight growth charts, skin, umbilical cord healing, teeth, elimination, gross motor skills, fine motor skills, sleep patterns, feeding and nutritional needs, normal ranges for vital signs
   b. Cognitive: reflexes, language acquisition, sensory development, play, Piaget
   c. Emotional-social: bonding, Erikson's psychosocial task, temperament vs. personality
   d. Appraise activities and techniques that optimize the development of the infant
   (TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 39, 40, 41, 42, 44; TN Sociology 20, 21,25)

8) Create an annotated model or graphic illustrating the parts of the human brain, detailing principle functions as they relate to physical and cognitive development. Draft a companion artifact on the stages of human development in the form of a timeline from toddlerhood through early adulthood. Draw conclusions from cases studies, news articles, and academic journals about the most important influences on and relationships among brain development, reasoning capacity, and learning. Define brain plasticity and describe how it changes over the lifespan. (TN Biology 4; TN Psychology 13, 14; FACS 12)

Toddlerhood

9) Research and outline the physical, cognitive, and emotional-social development that occurs during toddlerhood. Prepare an informational artifact for parents that describes this stage of growth and development with real life examples including, but not limited to the following:
   a. Physical: height and weight, body proportions, teeth, skeletal development, vital signs, gross and fine motor skills, sleep patterns
   b. Cognitive: sensory development, language acquisition/vocabulary, object permanence, recognition of body parts, understanding relationships between people and things, curiosity, concept of time, moral development, symbolic play, imagination, Piaget's preoperational thought
   c. Emotional-social: separation anxiety, independence, possessive phase, toilet training, Erikson's autonomy, self-concept, temper tantrums, regression, egocentric thinking
   d. Appraise activities and techniques that optimize the development of a toddler
   ~~(TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 43, 44, 45, 46; TN Sociology 20, 21, 25)~~

Preschool

10) Research and outline the physical, cognitive, and emotional-social development that occurs in preschool. Prepare an informational artifact for parents that describes this stage of growth and development with real life including but not limited to the following:
   a. Physical: height & weight, body proportions, teeth, musculoskeletal development, vital signs, gross and fine motor skills, sleep patterns,
   b. Cognitive: sensory development, depth perception, maximum visual ability, language acquisition/vocabulary, sexual curiosity, locates body parts, understanding of relationships between people and things, curiosity, concept of time, moral development, symbolic play, imagination, Piaget's preoperational thought and centration, concept formation
   c. Emotional-social: Erikson's initiative, jealousy, preschool socialization, friendships with other children, Freud's development of superego, cooperative play, fears
   d. Appraise activities and techniques that optimize the development of preschool age children
   ~~(TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 43, 44, 45, 46; TN Sociology 20, 21, 25)~~

School Age

11) Research and outline the physical, cognitive, and emotional-social development that occurs in school-age children. Prepare an informational artifact for parents that describes this stage of growth and development with real life examples including but not limited to the following:
   a. Physical: height and weight, musculoskeletal development, improvement of hand-eye coordination, permanent teeth, development of gastrointestinal and nervous systems, immune system maturation, vital signs, fine motor skills development, gender differences in motor skills, development of writing, strength acquisition and endurance, sleep and rest requirements

b. Cognitive: visual maturity, peripheral vision and depth perception improvement, Piaget's stage, numbering classifying of objects, increased attention span, developing problem-solving skills, improved memory, language development, academic learning
   c. Emotional-social: types of play, personality development, peer and sibling relationships, Freud's latency period, transition from Kohlberg's preconventional level of moral thought to conventional level of moral reasoning and beginning of reciprocity
   d. Appraise activities and techniques that optimize the development of school-age children
   (TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 43, 44, 45, 46; TN Sociology 20, 21, 25)

Puberty and Adolescence

12) Research and outline the physical, cognitive, and emotional-social development that occurs during puberty and adolescence. Prepare an informational artifact that describes this stage of growth and development with real life examples including, but not limited to the following:
   a. Physical: rapid growth to cessation of growth, development of secondary sex characteristics, maturing of reproductive system, changes in height and weight
   b. Cognitive: experimentation and learning, Piaget's shift from concrete thinking to formal operational thought processes, abstract thinking, formal problem solving
   c. Emotional-social: peer and romantic relationships, Erikson's search for identity, conflict with authority figures
   d. Analyze components of a healthy and safe environment during adolescence.
   e. Appraise activities and techniques that optimize the development of adolescences
   (TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 44, 45, 46, 47; TN Sociology 20, 21, 25)

Early Adulthood

13) Research and outline the physical, cognitive, and emotional-social development that occurs during early adulthood. Prepare an informational artifact highlighting steps for achieving optimum wellness during late adulthood, addressing at minimum the following:
   a. Physical: cessation of growth, peaking of physical functions and characteristics
   b. Cognitive: post conventional stage of moral development, continued development of intellectual and reasoning capacities
   c. Emotional-social: sexual maturation, Erikson's intimacy, development of a professional and personal identity
   d. Analyze components of a healthy and safe environment during early adulthood.
   (TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 45, 46, 48, 49, 50; TN Sociology 20, 21, 25)

Middle Adulthood

14) Research and outline the physical, cognitive, and emotional-social development that occurs during middle adulthood. Prepare an informational artifact highlighting steps for achieving optimum wellness during late adulthood, addressing at minimum the following:
   a. Physical: decline of physical functions and characteristics, increase in health risks due to genetic conditions or contraction of diseases
   b. Cognitive: plateau of mental capabilities, reevaluation of life purpose and meaning

     c.   Emotional-social: Erikson's task (generativity), evaluating and redesigning career options

     d.   Analyze components of a healthy and safe environment during middle adulthood.

     ~~(TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 45, 46, 48, 49, 50; TN Sociology 20, 21, 25)~~

Later Adulthood

15) Research and outline the physical, cognitive, and emotional-social development that occurs during later adulthood. Prepare an informative artifact that includes steps for achieving optimum wellness during late adulthood, addressing at minimum the following:

     a.   Physical: continued decline of physical functions and characteristics

     b.   Cognitive: cognitive decline, long-term versus short-term memory loss

     c.   Emotional-social: Erikson's ego integrity, changes in work and leisure

     d.   Analyze components of a healthy and safe environment during later adulthood.

     ~~(TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 38, 45, 46, 48, 49, 50; TN Sociology 20, 21, 25))~~

Death and Dying

16) Below are the most commonly listed stages of the grief model. Research and create graphic or artifact that explains each stage of the model. The graphic or artifact could include but not be limited to: definition of each stage, emotional and physical actions, and ways to cope.

     a.   Shock and Denial

     b.   Pain and Guilt

     c.   Anger and Bargaining

     d.   Depression, Reflection, and Loneliness

     e.   Upward Turn

     f.   Reconstruction and Working Through

     g.   Acceptance and Hope

    ~~(TN Reading 1, 2, 4; TN Writing 2, 7, 8, 9; TN Psychology 37, 50)~~

Final Project

17) Differentiate the major periods of life outlined in the course and describe major developmental changes and key tasks associated with each period. Create a timeline of a human from conception to age 100 following typical growth and development patterns outlining what is occurring at each stage. ~~(TN Reading 1, 2, 4, 7; TN Writing 4, 7, 9; TN Psychology 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50; FACS 12)~~

The following artifacts will reside in the student's portfolio:
- Methodologies artifact
- Human Growth & Development report
- Prenatal Development artifact
- Genetic artifact
- Human Development Stage artifacts
- Death and Dying artifacts
- Capstone Timeline graphic

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 4, 5, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~
- ~~TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.~~
- ~~TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Family Studies

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6136
Prerequisite(s):	None
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the third course in the *Social Health Services* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Family Studies is an applied knowledge course that examines the diversity and evolving structure of the modern family. Upon completion of the course, proficient students will have knowledge of the demographic, historical, and social changes of interpersonal relationships, as well as parenting, and the effect of stressors on the family. Artifacts will be created for inclusion in a portfolio, which will continue to build throughout the program of study. Standards in the course are aligned with Tennessee State

Approved April 10, 2015; Amended April 15, 2016

Program of Study Application

This is an applied knowledge course in the *Social Health Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Definition and History of Family

1) Drawing on academic research and news media, synthesize a definition of family in an informative essay. Analyze diverse family structures that are representative of today's society, citing specific textual evidence from research. (TN Reading 1; TN Writing 2, 9; TN Sociology 16, 21; FACS 6)

2) Research and summarize early records of the structures of family. Use the research to create a timeline or graphic illustrating changes in the structures of families over time. Research the historical events that contributed to changes in common family structures, including but not limited to:
   a. The Renaissance
   b. Slavery
   c. Industrialization of the economy
   d. Wars
   e. Women's right to vote
   (TN Reading 2, 9; TN Writing 8; TN U.S. Government and Civics 18, 46, 47, 48; TN US History and Geography 7, 18, 42, 94; FACS 6)

3) Compare and contrast different definitions of family units found in distinct groups. Explore cultural, geographical, religious, ethical, and political differences, analyzing the reasoning and evidence each provide for the development of their definition of a family. (TN Reading 8, 9; TN Sociology 17, 18, 23; FACS 6)

4) Form a hypothesis about how a specific community may have changed in response to major historical events (such as World War II). Compare and contrast census records to analyze demographic trends in the community over time and present findings in an informative essay. (TN Reading 1; TN Writing 2, 4, 6; FACS 6)

5) Conduct a research project examining relevant academic journal articles and news media coverage of a specific issue or trend in family studies. Supplement research with interviews and other primary sources to provide data and evidence for the development of particular phenomenon. Research topics may include, but are not limited to:
   a. *Sandwich* Generation
   b. *Failure to Launch*

        c. Grandparents raising grandchildren
(TN Reading 1, 2, 9; TN Writing 7, 10; TN Sociology 21; FACS 6, 15)

Family Cycle & Relationships

6) Create a graphic illustration that identifies the stages of the Family Life Cycle. Identify characteristics and changes at each of the stages. Summarize in an informative narrative, describing each stage and give examples of the changes in the family structure as an individual ages and passes through each stage. (TN Reading 1, 3, 7, 9; TN Writing 2, 8, 9; FACS 6, 15)

7) Identify intrapersonal and interpersonal conditions, personal characteristics, attitudes and behaviors necessary for effective human relationships, exploring concepts such as understanding of self, relationship building skills, conflict management and intimacy, citing textual evidence from social science academic research. (TN Reading 1, 5; TN Psychology 51, 55, 57, 60; TN Sociology 20, 21, 25; FACS 13)

8) Explore concepts of long-term relationships, such as love, mate selection, attachment, loneliness, conflict, and relationship dissolution, using social science academic research. Summarize relevant resources on the purpose and responsibilities of dating. Develop a logical framework of guidelines for mate selection using compatibility surveys, identifying factors that impact selection. Examine marriage laws in the state, prepare a list of requirements to obtain a marriage certificate, and describe legal rights provided through marriage, citing specific legislation and organizational policies. (TN Reading 1, 4, 5, 9; TN Writing 7, 9; TN Psychology 55, 60; TN Sociology 20, 21, 25; FACS 13)

9) Investigate types of crises impacting families (such as unemployment, child exceptionality, divorce, death), describing characteristics of crises situations and citing rates of frequency pulled from census information and news articles. Synthesize research on theories and strategies for helping families deal productively with crises by crafting an argumentative essay making a recommendation for a specific activity that can be used to assist families in crises situations. (TN Reading 1, 2; TN Writing 1, 7, 8, 9; TN Sociology 35, 36, 37; FACS 13)

10) Synthesize research to evaluate the importance of values and goals on individuals during the lifespan. Create a list of values that are observed in an individual's family of origin and a list of values that will be important in future family units. Compare and contrast the list for similarities and variations in a class discussion. (TN Reading 1, 9; TN Writing 2, 4; TN Psychology 47; TN Sociology 25; FACS 6)

Parenting Responsibilities

11) Differentiate between parenting styles described in social science academic research. Assess the extent to which the reasoning and evidence in a specific theory supports the claim(s). Parenting styles could include, but are not limited to:
        a. Authoritarian
        b. Permissive
        c. Authoritative
(TN Reading 1, 2, 8; TN Writing 2, 9; FACS 6, 15)

12) Identify ways to promote and foster a child's positive self-concept. Research case studies to identify positive guidance techniques, linking each to a specific reason for child misbehavior (such as desire for attention, embarrassment, lack of expectations, etc.). (TN Reading 1, 7, 9; FACS 6, 15)

13) Investigate the adoption process nationally and globally using advanced searches of both print and digital sources. Collaboratively, develop a list that compares and contrasts the costs and benefits of each adoption process. Identify local and global agencies that are available for assistance during the adoption process. (TN Reading 2, 7, 9; TN Writing 8, 9; FACS 6, 15)

Family Stress, Crisis, and Resilience

14) Research and summarize trends in family life since the integration of dual income households in America. Discuss the impact of these trends on traditional gender roles and responsibilities of family members. (TN Reading 1, 2, 9; TN Psychology 68; TN U.S. History and Geography 42; FACS 6)

15) Research the impact of poverty and social inequality on the structure of the American family. Develop a list of factors that contribute to income inequality and develop strategies that promote social mobility. (TN Reading 1, 2, 9; TN Writing 2, 8, 9; TN Psychology 65, 68, 69; TN Sociology 36 FACS 6)

16) Research each of the stages of the Cycle of Violence. Create a graphic illustration that identifies each of the stages, with short descriptions and prevention strategies for each stage to combat the recurrence of violence. (TN Reading 1, 2, 3, 9; TN Writing 2, 8, 9; FACS 6)

17) In a group, work to identify domestic abuse resources within a community. Make an informational resource for distribution in the community that could be used by the proper authorities in instances of domestic abuse. (TN Reading 1, 2, 9; TN Writing 2, 8, 9; FACS 6)

The following artifacts will reside in the student's portfolio:
- Definition of a Family Essay
- Graphic of Family throughout History
- Family Demographic artifacts
- Family Trend Research Paper
- Family Cycle graphic
- Dating guidelines
- Family Crisis Research artifacts
- Family Values assessment
- Parenting narrative
- Research on Parenting
- Family Violence Cycle illustration
- Domestic Abuse resources

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 4, 5, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 5 at the conclusion of the course.~~
- ~~TN Psychology: Tennessee Social Studies: Psychology 9-12 standards may provide additional insight and activities for educators.~~
- ~~TN Sociology: Tennessee Social Studies: Sociology 9-12 standards may provide additional insight and activities for educators.~~
- ~~TN U.S. Government and Civics: Tennessee Social Studies U.S. Government and Civics standards may provide additional insight and activities for educators.~~
- ~~TN U.S. History and Geography: Tennessee Social Studies: U.S. History and Geography standards may provide additional insight and activities for educators.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Nutrition Across the Lifespan

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6005
Prerequisite(s):	*Introduction to Human Studies* (6137)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the second course in the *Dietetics and Nutrition* program of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Nutrition Across the Lifespan is for students interested in learning more about becoming a dietitian, nutritionist, counselor, or pursing a variety of scientific, health, or culinary arts professions. Upon

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completion of this course, proficient students will understand human anatomy and physiological systems, nutrition requirements, as well as social, cultural, and other impacts on food preparation and integrity. Artifacts will be created for inclusion in a portfolio, which will continue to build throughout the program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Biology I, Chemistry I, Human Anatomy & Physiology (A&P), and Scientific Research, and the National Standards for Family and Consumer Sciences Education, Second Edition.*~~

Program of Study Application

This course is an applied knowledge course in the *Dietetics & Nutrition* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Safety & Sanitation

1) Compile and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government published fact sheets. Identify and review general common laboratory safety procedures including but not limited to prevention and control procedures and personal hygiene expectations. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3; FACS 9)~~

Nutrition and Health Overview

2) Synthesize research published by government agencies or academic journals on the contribution of nutrition and exercise to achieving optimum physical, mental, and social well-being at all stages of development across the life span. Create an informative essay illustrating findings on the nutritional needs of individuals and families in relation to age, gender, activity level, and health status. ~~(TN Reading 1, 7; TN Writing 2, 4, 7, 9; FACS 14)~~

Anatomy and Physiology of Nutrition

3) Create a model or graphic illustration that identifies the major anatomic structures of the gastrointestinal (GI) system. Explain the function of each structure in the process of digestion, absorption, transport, and use of nutrients in the body. Research and develop a logical explanation of how the body deals with deficiencies and surplus nutrients, citing specific textual evidence on the impact on an individual's health. ~~(TN Reading 1, 2; TN Writing 2, 8, 9; TN A&P 1, 5; FACS 9)~~

4) Identify, analyze, and visually represent the macro- and micro-nutrients required in the human diet. Include the common food sources of those nutrients, their chemical properties, and function in the body, as well as the influence upon biological systems in reference to maintenance and growth.
   a. Macro nutrients include: carbohydrates, lipids, and proteins
   b. Micro nutrients include: minerals, vitamins, and water
   ~~(TN Reading 1, 7; TN Writing 4; TN Biology 1; FACS 9, 14)~~

Nutritional Requirements Across the Lifespan

5) Accurately read, interpret, and communicate understanding of guidance from the U.S. Food and Drug Administration (FDA), and other regulators, such as nutrition labels and daily value recommendations using accurate symbols, key terms, and other domain-specific words and phrases. (TN Reading 4; FACS 9, 14)

6) Research and prepare informational artifacts for consumers that present the specific nutritional guidelines for each stage of the life span using scientifically accurate terms and symbols. Life span phases should include:
    a. Birth to 1 year
    b. Toddlerhood
    c. Preschool
    d. School age
    e. Puberty and adolescence
    f. Pregnant and lactating females
    g. Early adulthood
    h. Middle adulthood
    i. Late adulthood
    (TN Reading 1, 7; TN Writing 4, 6, 8; FACS 14)

7) Analyze a variety of meal plans that meet nutritional requirements (caloric and RDA) as recommended by the U.S. Food and Drug Administration (FDA). Create a meal plan that addresses the nutritional needs of a specific individual based on their age, gender, activity level and other factors, and justify choices using evidence. Select, prepare, and serve food(s) from the meal plan following recipes precisely, including defining and utilizing specific culinary and measurement terms as needed. Practice proper serving and etiquette principles during appropriate situations. (TN Reading 1, 3, 4; TN Writing 7; FACS 9, 14)

8) Keep a food journal and compare an individual's diet to nutritional recommendations for their respective age, gender, activity level, and health status. Write a summary of the findings and include conclusions drawn on recommendations of how the diet could be modified to make up for deficiencies and surpluses. (TN Reading 9; TN Writing 4; FACS 9, 14)

9) Compare and contrast alternative diet and lifestyle approaches to recommended dietary requirements for individuals of the same age and gender. Explain the reasons for the dietary differences in an informational artifact summarizing information to describe the physiological differences of the lifestyles, including, but not limited to:
    a. Differences in physical activity (i.e. athletic training)
    b. Differences in religious or ethical values (i.e. vegetarian, vegan, kosher)
    c. Differences based on disease or physiological need (i.e. gluten free, elimination or rotation diets)
    (TN Reading 1, 2, 8, 9; TN Writing 7, 8, 9; FACS 9)

Food Preferences and Choices

10) Research and summarize in an explanatory text the factors that contribute to food choices and preferences including cultural, geographical, economic, psychological, and societal influences. Describe the most likely results of preferences and external factors on nutritional intake.
   a. Example of geographical external factor on nutritional intake: Individual living in an area without adequate sunlight exposure may need to eat a diet rich in Vitamin D to make up for vitamin deficiency.
   b. Example of geographical preference on food choice: Individual living in a colder climate might prefer methods of cooking that keep heat in the living area, while an individual living in a warmer climate might prefer preparation methods that reduce heat. (TN Reading 1; TN Writing 2, 4, 7, 8, 9; FACS 14)

11) Form a hypothesis and design and conduct an experiment to identify the role of the senses and/or food preparation techniques in food choices. Summarize experiment results into an argument making a claim about the impact of variables on food choice. Compare results to findings in news media and note when findings support or contradict previous explanations or accounts. (TN Reading 1, 3, 7, 9; TN Writing 1, 4, 7, 8, 9; TN Scientific Research 3, 4, 5; FACS 9, 14)

12) Research nutritional claims of various diets and use appropriate/reliable sources of nutritional information to determine the validity of those claims. Use nutritional databases, food label information, and other sources to analyze the nutrient composition of one day of foods on each diet investigated. Create a graphic illustration comparing actual nutrition provided by each diet to the recommended nutrition requirements for an individual with specific characteristics, noting similarities and differences in two diets. (TN Reading 1, 2, 6, 7, 8, 9; TN Writing 6, 7, 8; FACS 9, 14)

Nutritional Issues and Controversies

13) Synthesize evidence from multiple sources to analyze topics in nutrition, including but not limited to:
   a. The use of genetically modified foods
   b. Artificial sweeteners versus natural sugar
   c. Organic and local food movements
   d. Benefits and risk of different forms of dieting
   e. Use of probiotics

   Evaluate the validity and credibility of source materials and deduce the principle arguments for each, carefully weighing the author's evidence against potential biases. (TN Reading 1, 2, 6, 8; TN Writing 4, 8; FACS 14)

14) Describe the correlation of energy balance, lifestyle, diet, age, gender, and metabolism to the obesity epidemic in America. Compare and contrast how different diets, habits, heredity, and physical characteristics contribute to obesity. Research various initiatives that have sought to fight obesity and improve nutrition across the nation. Summarize the intended result of an initiative in an explanatory essay, informational artifact, or presentation. (TN Reading 1, 2, 8; TN Writing 4, 7, 8; TN Biology 4; FACS 9, 14)

Food Preparation and Integrity

15) Investigate the food supply from point of origin to the point of sale – analyzing handling, transportation, storage, processing, and packaging – to identify where food safety and nutritional value could be compromised. Compare this to the food handling, transportation, storage, processing, and preparation from point of sale to the table by creating a graphic illustration indicating where food is most susceptible to contamination, food-borne illness, spoilage, and nutrient loss. (TN Reading 7; TN Writing 4, 9; FACS 9, 14)

16) Demonstrate food selection and preparation methods that maximize the nutritional value of foods while minimizing dietary health risks. Plan and conduct nutrition laboratory experiments to determine the physical and chemical changes of food structure through chemical reactions. Communicate results of experiences, including comparing and contrasting results to findings in a report. Demonstrate relationships among concepts including, but not limited to:
   a. Heat
   b. Acidity level
   c. Fermentation
   d. Millard reactions
   e. Chemically processed foods
   f. Preparation techniques and product yield
   (TN Reading 3, 5; TN Chemistry I 3; TN Scientific Research 3, 4, 5)

The following artifacts will reside in the student's portfolio:
   o Illustration of Nutrition Needs
   o Graphic or Model & Explanation of GI Tract
   o Macro & Micro Nutrient artifact
   o Informational Artifact for Consumers
   o Analysis of Meal Plans
   o Food Journal
   o Food Preferences artifact
   o Summarized Results from Food Prep Techniques Experiment
   o Illustration of Nutrition Claims
   o Nutritional Issues Comparison
   o Food Integrity illustration
   o Food Lab Reports

Standards Alignment Notes

*References to other standards include:
   - TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
      o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.

- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Nutrition Science & Diet Therapy

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6007
Prerequisite(s):	*Nutrition Across the Lifespan* (6005)
Credit:	1
Grade Level:	11
Graduation Requirements:	Satisfies one of three credits required for elective focus if taken in conjunction with other Human Services or Health Science courses. In addition, satisfies one credit of laboratory science required for graduation.
Programs of Study and Sequence:	This is the third course in both the *Dietetics and Nutrition* and *Therapeutic Clinical Services* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	050, 051, 154, 450, 577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Nutrition Science and Diet Therapy is an applied knowledge course in nutrition for students interested in the role of nutrition in health and disease. Upon completion of this course, proficient students will be able to develop a nutrition care plan as part of the overall health care process, use methods for analyzing the nutritional health of a community, and understand the relationship of diet and nutrition to specific diseases. The course places emphasize on the role of diet as a contributor to disease and its role in the prevention and treatment of disease. Artifacts will be created for inclusion in a portfolio, which

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will continue to build throughout the program of study. ~~Standards in this course are aligned to Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, and Tennessee Biology I, Chemistry I, Human Anatomy & Physiology (A&P), and Scientific Research standards, as well as the National Standards for Family and Consumer Sciences Education, Second Edition.*~~ **The following standards should be implemented throughout the course as well as suggested 30 hours of time spent in the laboratory.**

Program of Study Application

This course is an applied knowledge course in the following programs of study. For more information on the benefits and requirements of implementing these programs in full, please see the following websites:

- *Dietetics and Nutrition:* https://tn.gov/education/article/cte-cluster-human-services
- *Therapeutic Clinical Services:* https://tn.gov/education/article/cte-cluster-health-science

Course Standards

Safety & Sanitation

1) Compile and critique safety and sanitation procedures related to handling, preparing, storing, and serving food from industry-approved technical manuals and government fact-sheets. Identify and review general common laboratory safety procedures including but not limited to prevention and control procedures. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3; FACS 9)~~

Nutrition and Health Overview

2) Gather relevant information from multiple authoritative print and digital sources related to the importance of a balanced diet in the achievement of optimum nutrition. Compare and contrast nutritional needs of a normal healthy diet with the needs of a client being treated for and/or recovering from illness. Prepare an informative artifact to discuss the findings. ~~(TN Reading 7; TN Writing 2, 8, 9; FACS 9, 14)~~

Nutrient Metabolism

3) Create a model and/or graphic illustrating the major metabolic pathways that are used to produce energy for the body. Write a narrative report explaining the chemical processes that occur at each stage in the pathway. Categorize each stage as an anabolic or a catabolic reaction, citing relevant evidence from academic or medical materials. Stages include:
   a. Glycolysis
   b. Kreb's cycle
   c. Electron Transport
   d. Fermentation
   ~~(TN Reading 1; TN Writing 7; TN Biology II 3; FACS 9, 14)~~

4) Synthesize information on energy balance. Apply available tools and equations to calculate Estimated Energy Requirements (EER) for an individual. Determine the energy content of an individual's diet. Based on the client's EER and calculated caloric intake, predict the effect on the client's weight. Calculate the following:
   a. Physical Activity Level (PAL)
   b. Total Energy Expenditure (TEE)
   c. Basal Energy Expenditure (BEE)
   d. Thermic Effect of Food (TEF)
   e. Metabolic Equivalents (METs)
   (TN Reading 1, 3, 7; TN Writing 2, 7; TN Math N-Q; TN Biology Embedded Math; TN A&P 5; TN Scientific Research 4; FACS 9)

Nutrients and Their Relation to Disease

Water
5) Gather relevant information from multiple scientific and technical texts to evaluate and create a model or graphic that illustrates the scientific properties of water. Using the research, write an explanatory essay detailing the functions of water in its relation to food, digestion, and maintenance of the body. (TN Reading 2; TN Writing 2, 4; TN Chemistry I 1; FACS 9, 14)

6) In a class discussion, compare and contrast the diseases associated with contaminated drinking water and the mortality rate of impoverished regions or communities using resources such as the U.S. National Library of Medicine or the National Institutes of Health. (TN Reading 2, 9; FACS 9)
   Suggested Labs: The Purification of Water

Carbohydrates
7) Analyze research to determine domain-specific terms that describe the molecular structure of carbohydrates and fiber in relation to their scientific function in food, food preparation, and the body. Create a graphic illustration/model to compare and contrast the differences in complex and simple carbohydrates and fiber. (TN Reading 2, 4, 6; TN Chemistry I 1; FACS 9, 14)
   Suggested Labs: Hydrolysis of Sugar; Sweetness & Solubility; Digestion of Starch

8) Research the impact of carbohydrates on diabetes, differentiating between Type I and Type II. Cite specific textual evidence from academic research, medical literature, and news articles in order to:
   a. Describe the disease/condition, including symptoms and organ(s) affected.
   b. Justify the role of nutrition as a contributor to the disease/condition and highlight specific dietary recommendations for minimizing those contributions.
   c. Justify the role of nutrition in the treatment of the disease/condition, outlining a healthy eating plan and providing lists of specific foods/nutrients to reduce or exclude from the diet and those that should be included in the diet.
   d. Make recommendations for other lifestyle changes that will reduce the risk or aid in the therapy for the disease/condition.
   e. Prepare a menu item that meets the nutritional recommendations for diabetics.
   (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 4, 6, 7, 8; TN A&P 1, 3; FACS 9)
   Suggested Labs: Meal Preparation for diabetic patient; Count the Carbs activity

9) Research the correlation between starch consumption and Celiac Disease, citing evidence from academic journals and medical literature in order to
   a. Describe the disease/condition, including symptoms and organ(s) affected
   b. Explain the digestive problems and the impact on digestion and absorption of nutrients
   c. Make recommendations for other lifestyle changes that will reduce the risks or aid the therapy for the disease/condition
   d. Prepare a menu item that meets the nutritional recommendations for individuals with Celiac Disease
   (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 4, 6, 7, 8; TN A&P 1, 3; FACS 9)
   Suggested Labs: Compare & Contrast Alternative Ingredients for Gluten in Foods

Lipids
10) Analyze the properties and composition of lipids in relation to their functions in food preparation and to the body. Compare and contrast the composition of saturated and unsaturated fats using domain-specific terms in a class discussion or by creating a model/graphic. Write an explanatory text about the impact of nutrition on cardiovascular health, focusing on hypertension, stroke, and coronary artery disease. (TN Reading 2, 4, 6; TN Writing 2; TN Chemistry I 1; FACS 9, 14)

11) Investigate the correlation between fats in the diet and coronary artery disease, citing evidence from academic research, medical literature, and news articles in order to:
   a. Describe the disease/condition, including symptoms and organ(s) affected.
   b. Justify the role of nutrition as a contributor to the disease/condition, and highlight specific dietary recommendations for minimizing those contributions.
   c. Justify the role of nutrition in the treatment of the disease/condition, outlining a healthy eating plan and providing lists of specific foods/nutrients to reduce or exclude from the diet and those that should be included in the diet.
   d. Make recommendations for other lifestyle changes that will reduce the risks or aid the therapy for the disease/condition.
   e. Prepare a menu item that meets the nutritional recommendations for achieving good cardiovascular health.
   (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 4, 6, 7, 8; TN A&P 1, 3; FACS 9)
   Suggested Labs: Bomb Calorimeter; Extraction of Fat in Hot Dogs; Fat Content in Beef; Testing Oils in Frying; Alternative Fats in Foods; Low Fat Cookery Lab

Proteins
12) Cite textual evidence from academic research or medical literature to describe the molecular structure of proteins, and identify essential and nonessential amino acids. Compare and contrast complete and incomplete proteins by analyzing the functions of protein in food and their importance in the body. Research nutritional diseases related to insufficient protein. Describe ways in which protein is used in food preparation. (TN Reading 2, 4; TN Chemistry 1; FACS 9, 14)
   Suggested Labs: Effects of Minerals on Protein; Protein in Eggs

Minerals
13) Determine the meaning of domain-specific terms to analyze the properties and composition of minerals within the human diet. Write an explanatory text describing the chemical and molecular composition of different minerals. (TN Reading 2, 4, 6; TN Writing 2; TN Chemistry I 1; FACS 9, 14)

14) Drawing on findings from medical research, compare and contrast the advantages and disadvantages of the use of food additives in processed products. Create a list of regulations governing the use of food additives established by the Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA). (TN Reading 2, 4, 6; TN Writing 2; FACS 9, 14)
Suggested Labs: Conduct a sensory evaluation of foods with and without food additives

15) With regards to minerals and osteoporosis, cite specific textual evidence, medical literature, and news articles in order to:
   a. Describe the disease/condition, including symptoms and organ(s) affected.
   b. Justify the role of nutrition as a contributor to the disease/condition and highlight specific dietary recommendations for minimizing those contributions.
   c. Justify the role of nutrition as a in the treatment of the disease/condition, outlining a healthy eating plan and providing lists of specific foods/nutrients to reduce or exclude from the diet and those that should be included in the diet.
   d. Make recommendations for other lifestyle changes that will reduce the risks or aid the therapy for the disease/condition.
   e. Prepare a menu item that meets the nutritional recommendations for maintaining good bone health.
   (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 4, 6, 7, 8; TN A&P 1, 3; FACS 9)

Vitamins
16) Use nutritional journals or articles to investigate the chemical properties of water-soluble and fat-soluble vitamins. Create a graph that classifies each vitamin, the chemical properties, and deficiency signs in the human body. (TN Reading 2, 4, 6; TN Writing 2; TN Chemistry I 1; FACS 9, 14)
Suggested Labs: Vitamin C Titration (using pipettes); Fat Soluble Vitamins

17) Write a research paper or conduct a project on one of the following diseases linked to vitamin consumption issues, using appropriate digital search resources and academic writing. Summarize symptoms, common causes, prevention strategies, and treatments. Topics might include but are not limited to:
   a. Beriberi
   b. Pellagra
   c. Scurvy
   d. Rickets
   (TN Reading 1; TN Writing 2, 8, 9; FACS 9, 14)

Clinical Nutritional Assessments

18) Compare and contrast the types of data collected, the insights they give into the nutritional status of a client, and the limitations of the data for the following four types of nutritional assessments used by a registered dietitian or other trained health care professional.
   a. Historical information
   b. Anthropometric data
   c. Physical examination
   d. Laboratory tests (TN Reading 1, 2; TN Writing 7, 8, 9; TN A&P Embedded Inquiry; FACS 9)

Nutrition Diagnosis and Intervention

19) Prepare a presentation or informative essay that explains the Nutrition Care Process to clients and/or their families and the role it plays in the total health care of a client. Outline what occurs in each of the four phases of the process: nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation. Include a list of frequently asked questions and their answers. (TN Reading 1, 2; TN Writing 6; TN A&P 1, 5; FACS 9)

Diet Analysis

20) Quantify the nutrient intake of individuals based on food journals, observations, or other reports. Using appropriate databases, determine the intake of macro- and micro-nutrients. Graph the results compared to the recommended intake of each nutrient. Write an explanation on why the data collected and analyzed would or would not be sufficient to make dietary changes. (TN Reading 2; TN Writing 6; FACS 9)

Behavioral-Environmental Assessments: The Individual Community

21) Review the tools for assessing community nutritional environment. Select one tool that identifies existing problems in the local community. Prepare a public serve announcement in the form of an editorial, a brochure, an online advertisement, or other artifact with the purpose of informing community members about the problem(s). (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 7; FACS 9)

22) Compare issues related to hunger and malnutrition, food insecurity, and food insufficiency locally, nationally, and globally. Describe short-term and sustainable development relief efforts used to combat these problems. (TN Reading 1, 2, 8; TN Writing 4, 7, 8; FACS 9, 14)

The Relationship of Nutrition to Specific Diseases

Obesity
23) Investigate obesity using academic research and news articles. Cite specific textual evidence in order to
    a. Describe the need for prevention of obesity to begin at an early age.
    b. Analyze the relationship between fat cell development and metabolism and the role of set-point theory in maintaining weight losses or gain.
    a. Differentiate between causes of obesity including genetics and environmental factors.
    b. List health problems associated with obesity. Include the dangers of fad diets, weight loss products and other gimmicks.
    c. Justify the use of a research-based weight-loss strategy that ensures adequate nutrition.
    d. Make a claim about the need for extreme measures (such as surgery) for extreme cases, supporting claim(s) with reasoning and evidence from research.
    e. Compare and contrast the impacts of lifestyle changes to increase physical activity, address stress and change environmental factors on an individual's weight.
    f. Make recommendations on activities necessary for the maintenance of weight loss.
(TN Reading 1, 2, 3, 4, 7, 8, 9; TN Writing 2, 4, 6, 7, 8; TN Math N-Q; TN Biology Embedded Math; TN A&P 5; TN Scientific Research 4; FACS 9) *Suggested Labs*: Anthropometry Lab; Nutritious Snack Lab

Eating Disorders

24) Differentiate between the major eating disorders (anorexia, bulimia, binge eating) and other forms of disordered eating to create a research project specifically addressing the following:

    a. Describe the disease/condition, including symptoms and specific ways the body is affected.

    b. Justify the role of nutrition as a contributor to the disease/condition and highlight specific dietary recommendations for minimizing those contributions.

    c. Justify the role of nutrition in the treatment of the disease/condition, outlining a healthy eating plan and providing lists of specific foods/nutrients to reduce or exclude from the diet and those that should be included in the diet.

    d. Make recommendations for other lifestyle changes that will reduce the risk or aid in the therapy for the disease/condition.

    (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 1, 2, 4, 6, 7, 8; TN A&P 4, 5; FACS 9)

    Suggested labs: Demonstrate the effect of acid erosion on teeth

Acids & Bases and their Relationship to Digestion

25) Using scientific articles and domain-specific vocabulary, define *acidic* and *basic* as they relate to nutrition. Create a pH scale including examples of common acidic and basic foods. In an accompanying narrative, summarize symptoms, common causes, and treatments for heartburn, acid indigestion, and ulcers. (TN Reading 1; TN Writing 2, 8, 9; TN Chemistry I 11)

    Suggested Labs: Acids & Bases Indicators in Food

26) For each of the following common digestive problems, summarize symptoms, common causes, prevention strategies, and treatments. Explain how they can impact the digestion and absorption of nutrients in the digestive system.

    a. Choking

    b. Vomiting

    c. Diarrhea, irritable bowel syndrome, colitis

    d. Constipation

    e. Belching and gas

    f. Heartburn and acid indigestion

    g. Ulcers

    (TN Reading 1, 2; TN Writing 2, 4, 7, 8, 9; TN A&P 5; FACS 9)

Food Intolerance and Allergies

27) Differentiate between food allergies and food intolerances, and describe the body's reaction to each. Research the eight most common food allergens. Describe treatment for an allergic reaction. Cite specific textual evidence in the application of knowledge, including:

    a. Describe how the immune system of a person with a food allergy responds when exposed to the food allergen. Contrast this to reactions originating from a food intolerance.

    b. Outline precautions to take when avoiding food allergens and/or foods to which they have an intolerance both at home and when eating out.

    c. Recommend food substitutes and recipe modifications to avoid problematic foods, citing specific reasoning and evidence to justify the recommendation.

    (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 1, 2, 4, 6, 7, 8; TN A&P 4, 5; FACS 9)

    Suggested labs: Using indicators identify which "student" (solution) is allergic (shows reaction to) to an allergen

Nutrition and Cancer

28) Assess the impact of nutrition on cancer focusing on the body sites affected. Cite specific textual evidence from academic research, medical literature, and news articles in order to:
   a. Describe the disease/condition, including symptoms and organ(s) affected.
   a. Justify the role of nutrition as a contributor to the disease/condition and highlight specific dietary recommendations for minimizing those contributions.
   b. Justify the role of nutrition in the treatment of the disease/condition, outlining a healthy eating plan for those undergoing treatments such as chemotherapy and radiation, and providing lists of specific foods/nutrients that act as antipromoters from the diet and those that should be included in the diet.
   c. Make recommendations for other lifestyle changes that will reduce the risk or aid in the therapy for the disease/condition.
   d. Prepare a menu item that meets the recommendations for reducing the nutritional risks for developing cancer.
   (TN Reading 1, 2, 4, 7, 8, 9; TN Writing 1, 2, 4, 6, 7, 8; TN A&P 1, 4, 5; TN Biology I 1; FACS 9)

29) From class research on the relationship between nutrition and specific diseases, select a topic where the need for further research has been identified. As a class or in small groups, outline the design for an experiment to continue the research. (TN Scientific Research 1, 2, 3; FACS 9)

The following artifacts will reside in the student's portfolio:
   o Nutrition and Illness
   o Metabolic Pathways graphic
   o Nutrition Care Process Diagnosis
   o Diet Analysis graph
   o Food and Nutrient Delivery
   o Public Service Announcement
   o Artifacts on Disease, Intolerance, and Condition and their relationship to Nutrition

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Interpreting Functions and Statistics and Probability.

- ~~TN Chemistry I: Tennessee Science: Chemistry I standards may provide additional insight and activities for educators.~~
- ~~TN Biology: Tennessee Science: Biology I standards may provide additional insight and activities for educators.~~
- ~~TN A&P: Tennessee Science: Human Anatomy and Physiology standards may provide additional insight and activities for educators.~~
- ~~TN Scientific Research: Tennessee Science: Scientific Research standards may provide additional insight and activities for educators.~~
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, FACS.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Human Services Practicum

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	6138
Prerequisite(s):	*Family Studies* (6136) or *Nutrition Science and Diet Therapy* (6007)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Human Services courses.
Programs of Study and Sequence:	This is the fourth and final course in both the *Dietetics & Nutrition* and *Social Health Services* programs of study.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	050, 051, 154, 450
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-human-services

Course Description

Human Services Practicum is a capstone course in the human services cluster that provides a practicum experience for students as they develop an understanding of professional and ethical issues. The capstone course will be based on the knowledge and skills from previous courses in the human services cluster. Upon completion of the course, students will be proficient in components of communication, critical thinking, problem solving, information technology, ethical and legal responsibilities, leadership, and teamwork. Instruction may be delivered through school-based laboratory training or through work-

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based learning arrangements such as cooperative education, mentoring, and job shadowing. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects as well as Tennessee State Standards for Psychology and Sociology.*~~

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the capstone course in the *Dietetics & Nutrition* and *Social Health Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Human Services website at https://tn.gov/education/article/cte-cluster-human-services.

Course Standards

Professionalism, Ethics, and 21st Century Skills

1) Collaboratively, develop a professionalism rubric with performance indicators for each of the following professional attributes and use it to evaluate course assignments and personal work:
    a. Attendance/punctuality
    b. Professional dress and behavior
    c. Positive attitude
    d. Collaboration
    e. Honesty
    f. Respect
    g. Responsibility
    h. Appropriate technology use
    ~~(TN Writing 7)~~

2) Select and research a professional organization in a counseling area of choice. Cite specific textual evidence from the organization and news articles to summarize:
    a. The mission of the organization
    b. Benefits of belonging to the organization
    c. Credentials provided and how they are obtained and maintained
    d. Journals, newsletters, and other documents and reports it publishes
    e. Educational opportunities provided
    f. Conferences held
    g. Membership costs, levels, student memberships

> h. Website, contact information

3) Collect Codes of Ethics from various counseling-related professional organizations and examine areas of commonality. Participate in a class discussion on the significance of including standards in these areas. Synthesize principles from the codes investigated to create a personal code of ethics.

Stress Management

4) Describe how stress affects the body and how it impacts relationships. List common stressors and ways to relieve stress and build resilience, citing specific textual evidence from academic and news media.

5) Evaluate personal stress level and ability to cope with stress using the Holmes and Rahe Stress Scale and the Resiliency Center's resiliency quiz (or other appropriate instruments). Identify stressors in your life and create a written plan to address specific stressors, as well as to incorporate one or more general stress relievers into your daily life, justifying recommendations with reasoning and evidence from research.

6) Interview individuals working in a human services occupation (such as counseling, social work, or consumer services) concerning stressors they encounter in their profession. Using evidence compiled from the interviews, participate in a class discussion addressing the stressors associated with counseling fields and how job stress might be reduced or dealt with.

Counseling Policies and Practices

7) Analyze authentic case studies of counseling situations and assess in writing the degree to which their proposed resolutions are supported by legal and ethical policies, citing specific textual evidence from codes of ethics, legislation or other appropriate materials.

8) Practice effective verbal, nonverbal, written, and electronic communication skills for working with clients while demonstrating the ability to: empathize, motivate, listen attentively, speak courteously and respectfully, defuse client's anger or skepticism, resolve conflicting interests, and respond to client objections or complaints to the client's satisfaction.

9) Work in a team to identify local area public and private agencies, businesses, and other entities that provide counseling services. Conduct phone or face-to-face interviews with a business to find out the specific services offered, fee structure, location(s) and hours, contact information and other information people seeking such services might require. As a class, compile a referral guide to human services in your area. Counseling services might include but are not limited to:
   a. Family
   b. Marriage
   c. Nutrition/Diet
   d. Career
   e. Social services
   f. Grief
   g. Substance abuse

> h. Financial
> ~~(TN Writing 6, 7)~~

The Counseling Environment

10) Synthesize relevant research to prepare a checklist by which prospective environments could be evaluated to determine suitability for a counseling practice. Draft indicators to evaluate the degree to which the environment inspires client confidence in the services provided. Include but do not limit the checklist to location, proximity to transportation, safety, and functionality of office layout. ~~(TN Reading 1, 7, 9; TN Writing 7)~~

11) Gathering principles of effective design from multiple sources, develop standard operating procedures for a counseling services office that include but are not limited to:
   a. Maintaining patient confidentiality
   b. Office safety
   c. Emergency procedures
   d. Workplace accident and incident reports
   ~~(TN Reading 7; TN Writing 2, 4, 6)~~

Practicum

12) Apply skills and knowledge from previous courses in an authentic work-based learning internship, job-shadow, or classroom-based project. Where appropriate, implement activities and use artifacts developed in previous courses.

13) Document the practicum using a journal to draw connections between the experience and previous course content by reflecting on:
   a. Tasks accomplished and activities implemented
   b. Positive and negative aspects of the experience
   c. Interactions with clients and professionals
   d. Personal satisfaction
   ~~(TN Writing 4, 9)~~

14) Upon conclusion of the practicum, produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the experience. ~~(TN Writing 4, 6)~~

The following artifacts will reside in the student's portfolio:
- Professionalism Rubric
- Professional Organization Brochure
- Personal Code of Ethics
- Stress Management
- Counseling Referral Guide
- Counseling Environment Checklist
- Practicum Checklist
- Practicum Journal
- Practicum Presentation

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3, 5, and 6 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Social Health

Primary Career Cluster:	Human Services
Consultant:	Elizabeth Rafferty, (615) 532-2840, Elizabeth.Rafferty@tn.gov
Course Code(s):	0562
Prerequisite(s):	None
Credit:	N/A
Grade Level:	5-8
Graduation Requirements:	N/A
Programs of Study and Sequence:	This course serves as a middle school primer for all programs of study in the Human Services and Education and Training career clusters.
Aligned Student Organization(s):	Family, Career and Community Leaders of America (FCCLA): http://www.tennesseefccla.org/ Dina Starks (interim), (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://www.tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	001, 050, 051, 101, 154, 400, 401, 402, 440, 450, 499
Required Teacher Certifications/Training:	None
Teacher Resources:	https://www.tn.gov/education/article/cte-cluster-human-services

Course Description

Introduction to Social Health is a foundational middle school course in the Education & Training and Human Services clusters. Upon completion of this course, a proficient student will understand components of healthy lifestyles and relationships, communication skills, relationship development, technology uses, and career exploration. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy for Grades 6-8 and the National Family and Consumer Sciences Standards, Second Edition.*

Approved April 10, 2015; Amended April 15, 2016

Course Standards

Healthy Lifestyles

1) Analyze the relationship between eating, sleeping, physical activity, and wellness. Assess nutrition and fitness practices that promote personal wellbeing across the life span. (TN Reading 1, 2, 7; TN Writing 7; FACS 14)

2) Describe the body's use of nutrients and identify nutritional food sources. Cite current nutrition guidelines to classify foods and identify recommended servings. Read and evaluate food label information; compare and contrast nutrition of various snacks and fast food; and use this information to create a well-balanced menu plan for adolescents. (TN Reading 1, 9; TN Writing 2, 7; FACS 14)

3) Compare food costs and determine whether there is a correlation between nutritional value and food cost. Define *food deserts* and describe their potential negative impact on community health. (TN Reading 4; FACS 14)

4) Demonstrate safe food and equipment handling procedures while preparing healthful snacks. Create an informational artifact explaining the nutritional value of the snacks. (TN Writing 2, 3, 4; FACS 14)

5) Draw evidence from informational texts to compare and contrast aerobic and anaerobic physical fitness activities. Develop a plan for participating in either team or individual activities that provide physical benefits, along with daily practices requiring no special equipment. (TN Reading 1, 9; TN Writing 2, 4; FACS 14)

Lifespan Development

6) Examine the interactions of physical, cognitive, and emotional-social development that occurs during each phase of the lifespan. Create an informative poster that describes one of the stages of growth and development. (TN Reading 3; TN Writing 7; FACS 12)

7) Research and outline the physical, cognitive, and emotional-social development that occurs in puberty and adolescence. Work in a small group to create a presentation to present to the class. (TN Reading 8; FACS 12)

Healthy Relationships & Communications

8) Analyze the different types of relationships and the characteristics of each. Compare and contrast healthy and unhealthy relationships by addressing issues including but not limited to the need for trust, respect and emotional support vs. bullying (cyberbullying), and verbal, physical, and emotional abuse. (TN Reading 1, 2, 9; FACS 13)

9) Examine methods of coping with personal and family change or crisis. Role-play positive parent-child and sibling communication. Explore conflict management, negotiation, problem-solving and anger-control strategies. Research and compile a list of resources (counseling, hotlines, support groups, etc.) for help in challenging circumstances. (TN Reading 9; TN Writing 2, 4, 7, 9; FACS 13)

10) Practice giving and receiving instructions to accomplish a complex task. Recognize the consequences of poor communication skills and describe the importance of good communication between team members. (FACS 13)

11) Articulate and convey situations related to school, relationships, and family. Practice active listening and appropriate "I" statements. (TN Reading 4; TN Writing 4; FACS 13)

Career Exploration

12) Complete one or more career-choice survey instruments. Evaluate personal interests, traits, abilities, and goals to maximize future educational and career opportunities. (TN Reading 2; FACS 1)

13) Research one of the sixteen nationally recognized career cluster and identify three to five possible careers in that cluster. Determine the knowledge, skills, and attributes associated with the occupations. Compare and contrast the educational and licensing requirements for obtaining a position and for career advancement. (TN Reading 1, 2, 7; FACS 1)

Resource Management

14) Research the different types of goals and list the different characteristics of each. Write specific, measurable, and attainable goals (such as postsecondary education, car ownership) and explore logical strategies for achieving them. (TN Writing 4)

15) Describe the importance of effective money management and its relationship to achieving goals. Construct a spending plan for one of the goals identified previously in the course. (TN Reading 1, 2, 7; FACS 2)

16) Create a time tracking system, such as a time log, to analyze the percentage of time spent each day on broad categories such as sleeping, eating, travel, school assignments, socializing, work, family, chores. Use the system to develop a plan for more effective use of time. (TN Writing 4; FACS 2)

Appropriate Technology Use

17) Practice responsible and safe use of technology. Create a list of best practices related to computer netiquette, privacy, security, and copyright laws. (TN Writing 4)

18) Use technology to access, manage, create, manipulate, and interpret information. Evaluate the content of a webpage to assess its reliability and trustworthiness. Cite sources of information correctly. Demonstrate proficiency with communication technologies to prepare publications and produce other creative works. (TN Reading 1, 6, 8; TN Writing 4, 6, 9)

19) Use technology to prepare and deliver a presentation. Evaluate delivery options based on topic, audience characteristics, and desired outcomes. ~~(TN Writing 6)~~

Standards Alignment Notes

*References to other standards include:
- TN Reading: <u>Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects</u>; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 6-8 Students (page 62).
  - o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: <u>Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects</u>; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 6-8 Students (pages 64-66).
  - o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5 and 10 at the conclusion of the course.
- FACS: National Standards for Family and Consumer Sciences Education, Second Edition: National Association of State Administrators of Family and Consumer Sciences, <u>FACS</u>.
- P21: Partnership for 21st Century Skills <u>Framework for 21st Century Learning</u>
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Information Technology Foundations

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6095
Prerequisite(s):	None
Credit:	1 credit for core and two focus areas. 2 credits for all 28 standards.
Grade Level:	9
Graduation Requirement:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the first course in the *Networking Systems, Programming and Software Development,* and *Web Design* programs of study.
Aligned Student Organization(s):	Future Business Leaders of America (FBLA) www.fblatn.org Sarah Williams, (615) 532-2829, Sarah.G.Williams@tn.gov Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active work-based learning (WBL) Certificate issued by the Tennessee Department of Education may offer appropriate student placement. To learn more, please visit: https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	153, 311, 435, 436, 475, 476, 582, 595, 740
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Approved January 30, 2015; Amended April 15, 2016

Course Description

Information Technology Foundations (ITF) is a course intended to provide students with exposure to various information technology occupations and pathways such as Networking Systems, Programming and Software Development, and Web Design. As a result, students will complete all core standards, as well as standards in two of three focus areas. Upon completion of this course, proficient students will be able to describe various information technology (IT) occupations and professional organizations. Moreover, they will be able to demonstrate logical thought processes and discuss the social, legal, and ethical issues encountered in the IT profession. Depending on the focus area, proficient students will also demonstrate an understanding of electronics and basic digital theory; project management and teamwork; client relations; causes and prevention of Internet security breaches; and writing styles appropriate for web publication. Upon completion of the ITF course, students will be prepared to make an informed decision about which Information Technology program of study to pursue. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.~~*

The following implementation options are encouraged:
- 1 credit for core and two focus areas (listed below)
- 2 credits for all 28 standards

Core standards are required for both one and two credit implementation options.
Core standards: 1, 2, 7, 8, 22

Focus Areas	Standards
Networking Systems:	3, 4, 5, 6, 10, 12, 15, 24
Programming & Software Development:	16, 26, 27, 28
Web Design:	9, 11, 13, 14, 17, 18, 19, 20, 21, 23 25

Program of Study Application

This is the first course in the *Networking Systems, Programming and Software Development,* and *Web Design* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including (1) rules published by the National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Internet safety, (4) Occupational Safety and Health Administration (OSHA) guidelines, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. ~~(TN Reading 3, 4)~~

Electronics and Basic Digital Theory

3) Demonstrate understanding of electrical circuits and devices, and relate to the physical laws (such as Ohm's Law and power laws) that govern behaviors of electrical circuits and devices. Accurately apply these physical laws to solve problems. For example, calculate the resistance of a DC circuit with a given DC voltage and current. (TN Reading 3, 4; TN Math N-Q, A-CED, A-REI, F-BF)

4) Assemble the required connections of electronic test equipment to properly test the operation of basic electronic circuit behavior and performance, using equipment such as a digital multimeter. For example, demonstrate the proper use of a digital multimeter by measuring resistance of a circuit in a typical computer system; compare this finding by calculating the resistance given the voltage and current. (TN Reading 3; TN Math N-Q)

5) Distinguish between the binary and hexadecimal counting systems. Using appropriate units, provide examples of each system and identify specific instances when IT professionals rely on them. (TN Reading 4; TN Math N-Q, A-CED)

6) Explain the functions of gates in logic circuits (e.g., AND, OR, NOT). For example, construct a truth table for the seatbelt warning light in an automobile. (TN Reading 3, 7)

Career Exploration

7) Research various occupations in information technology industries, such as programmers, web designers, webmasters, networking administrators, computer systems administrators, and telecommunications line installers. Compose an informative table or chart that includes the following: work activities typically performed, tools and technology used, nature of work environment, and the knowledge and skills needed for success. (TN Writing 4, 7)

8) Explore various professional societies related to information technology and identify the services and benefits provided by each member. Create a table that lists their purposes, benefits to membership, and any certifications affiliated with the organization. For example, investigate the Institute for Electrical and Electronics Engineers (IEEE), Computing Technology Industry Association (CompTIA), and the Association for Computing Machinery (ACM). (TN Reading 1; TN Writing4)

Overview of the Internet

9) Drawing on multiple sources (i.e., internet, textbooks, videos, and journals), research the history of the Internet. Create a timeline or infographic, illustrating the Internet's historical evolution from its inception to the present time. Discuss the needs that led to the creation of the Internet; discuss both the benefits and disadvantages of the Internet to society, as well as potential implications for the future. Provide examples drawn from the research to support claims. (TN Reading 1, 7; TN Writing 2, 8)

Overview of Operating Systems

10) Drawing on multiple sources (i.e., internet, textbooks, videos, and journals), research the history and development of operating systems (e.g., Microsoft Windows, Linux, UNIX). Create a presentation, illustrating their historical evolution, from their inceptions to the present, citing information found in research. Compare and contrast the general capabilities of a variety of operating systems, and explain how their designs and functionalities have improved over time. (TN Reading 1; TN Writing 2, 7, 8, 9)

Terminology and Concepts

11) Demonstrate an understanding of basic web terminology and concepts. Practice explaining these terminologies and concepts by creating methods to help students learn and remember the information. For example, students should be able to explain the purpose of terminology such as server, domain name system (DNS) , internet service provider (ISP), hardware and software connective devices, cloud computing, remote access protocols, map protocols, content management systems (CMS), cascading style sheets (CSS), and social networking terms. (TN Reading 1, 4)

12) Demonstrate a basic understanding of computer hardware components. Identify these components using pictures or actual models and briefly explain the function of each. Components should include, but are not limited to:
    a. Hardware used for input and output
    b. Hardware inside the computer case
    c. Motherboard
    d. Processor and the chipset
    e. Storage devices (e.g., primary, secondary)
    f. Expansion cards
    g. Electrical system
    (TN Reading 1, 4, 7)

Keyboard Shortcuts

13) Identify, explain, and demonstrate the use of common keyboard shortcuts. Create a quick reference guide that would be user-friendly for a novice web designer. For example, students may create a multiple column table showing keyboard shortcuts for navigation, text editing, and text formatting. The table would identify which shortcuts are applicable to using Windows versus Mac OS. (TN Reading 1, 9; TN Writing 4)

Introduction to Logical Thought Process

14) There are different versions of the web design and development process. For example, most versions of the web design and development process involve project definition, site structure, visual design, site development, testing, refining, and launch. Using various resources, research, identify, and explain the steps involved in the process. As a class, develop an agreed-upon framework for applying the logical thought process to web design projects in the form of a flowchart or logic model, justifying the reasoning behind each step. Explain why it is an iterative process and always involves refinement. (TN Writing 1, 4)

15) Research, identify, and describe the specific activities involved at each step of the troubleshooting process, including by not limited to:1) gather information from the user or operator and back up data, 2) verify the problem exists, 3) isolate the cause of the problem and generate alternative solutions, 4) plan a solution and resolve the problem, 5) verify that the problem was resolved and prevent a future occurrence, and 6) document findings, resolution, and preventative maintenance plan. Explain why it is important to document the process throughout. (TN Reading 7; TN Writing 2, 4, 7)

16) Demonstrate an understanding of flowcharts and know what various symbols mean. Identify a problem that a programmer would solve using the logical thinking process, and create a flowchart that would guide the code development. For example, create a flowchart that incorporates at least three decisions, or paths, to solve a problem. (TN Reading 3, 4, 7; TN Writing 2, 4)

Teamwork & Project Management

17) Explore how teams are formed to complete and manage web design and development projects. Using the information gained from research, identify and explain various roles and responsibilities for members of a web design and development team. Include why teams are more efficient than individuals in the web design and development process. Present the findings to classmates. (TN Reading 7; TN Writing 2, 4, 7, 9)

18) Synthesize common principles and templates for successful project management. Explain, using examples, why strong management skills are important in the web design and development process. (TN Reading 1, 2, 4)

Client Relations

19) Research and identify the skills that are required to communicate effectively with a client. Develop a questionnaire that would be used to determine the needs of a client for a prospective web development project. Using the questionnaire, conduct mock client interviews with classmates and provide each other with constructive feedback to revise the questionnaire and process. (TN Reading 1; TN Writing 4, 5, 7)

Writing and Editing for Web Publication

20) As a team, list primary rules to guide writing content that is appropriate for a web site publication. Apply these rules to a variety of web-based writing assignments throughout the course. For example, develop and maintain a blog throughout the course to practice appropriate writing techniques and style for web publication. (TN Reading 1, 3; TN Writing 4, 5)

21) Given a specific client's vision, create a simple web site using a content management system (CMS) such as WordPress. Follow the multistep process to download the software application of choice, and demonstrate how to upload and store files. Practice proofreading and critiquing other classmates' sites, and provide constructive feedback on one another's writing and layout design. (TN Reading 3; TN Writing 4, 5, 6)

Social, Legal, and Ethical Issues

22) Drawing on multiple sources (i.e., internet, textbooks, videos, and journals), research the various social, legal, and ethical issues encountered by IT professionals. Using these findings, identify the roles and responsibilities one must consider while developing a prospective project or addressing an IT problem. For example, web developers and programmers must apply copyright laws and understand uses of open source software. (TN Reading 1, 4)

Security

23) Demonstrate an understanding of the various security breaches that can occur with the Internet. Prepare a text explaining enterprise-level security, the purpose of encryption, and the protocols that can be implemented to secure web sites. Evaluate personal privacy issues versus employers' rights to regulate computing resources. (TN Reading 2, 4, 5; TN Writing 2, 4)

24) Identify various security practices for computer and network systems, such as how to control access to secured resources and computer resources. Give specific examples of methods that an administrator can use, like encryption techniques, basic input/output system (BIOS) features, and strategies for dealing with malware. (TN Reading 1, 4)

Organization of Materials

25) Understand and demonstrate the effective use of file and folder management techniques to maintain directory structure for a web site. Describe the most efficient methods for digital file management, including the use of site root and subfolders for assets (e.g., images, templates, CSS). (TN Reading 3, 4)

Programming

26) Explore and identify various languages, such as Python, HTML, PHP, C++, Visual Basic, Java, JavaScript, and C#. Explain how programmers use these languages to solve a variety of IT problems, furnishing examples of how they are applied. (TN Reading 1, 4, 7)

27) Using various resources, research, identify, and explain the steps involved in the software development life cycle, including but not limited to: planning, designing, coding, testing, deployment, and maintenance. Explain why it is an iterative process and always involves refinement. (TN Reading 2, 6, 7; TN Writing 4, 7)

28) Demonstrate an understanding of how batch files function within a programming environment. Identify common commands to create code for batch files (e.g., title, echo, echo off, pause, CLS, ipconfig, and ping). For example, list various scenarios for using batch files to complete specific programming tasks. Create and execute batch file code to perform one of the tasks identified. (TN Reading 3, 4, 8)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Programming & Logic I

Primary Career Cluster:	Information Technology
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6098
Prerequisite(s):	*Algebra I* (0842, 3102), *Information Technology Foundations* (6095)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses.
Programs of Study and Sequence:	This is the second course in the *Programming & Software Development* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	037, 041, 055, 056, 057, 152, 153, 203, 204, 311, 434, 435, 436, 474, 475, 476, 595, 740, 742
Required Teacher Certifications/Training:	Endorsements 474, 475, 476 require the equivalent of twelve semester hours of computer course work including at least six hours of programming language.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

Programming & Logic I is a course intended to teach students the basics of computer programming. The course places emphasis on practicing standard programming techniques and learning the logic tools and methods typically used by programmers to create simple computer applications. Upon completion of this course, proficient students will be able to solve problems by planning multistep procedures; write,

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analyze, review, and revise programs, converting detailed information from workflow charts and diagrams into coded instructions in a computer language; and will be able to troubleshoot/debug programs and software applications to correct malfunctions and ensure their proper execution. Standards in this course are aligned with the Tennessee State Standards for English Language Arts Standards and Literacy in Technical Subjects and Tennessee State Standards for Mathematics.*

Program of Study Application

This is the second course in the *Programming & Software Development* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Computer Programming Overview

1) Using news articles and instructional materials, investigate key milestones in the development of computers and logical devises. Create and present a document and/or illustration depicting the timeline of development that led to modern-day operating systems, programmable controllers, and widespread digital communications via the Internet and wireless networks, citing specific textual evidence. (TN Reading 1, 2; TN Writing 2, 4)

2) Compare and contrast the benefits, features, and typical applications of common modern programming languages and environments. Craft an argument to defend the choice of a certain language to solve a particular problem, developing claim(s) and counterclaim(s) with specific textual evidence and reasoning. (TN Reading 1, 2, 4, 5; TN Writing 1, 4)

Ethics

3) Using news articles and text of legislation, analyze ethical programming practices, including but not limited to the issues of confidentiality, privacy, piracy, fraud and misuse, liability, copyright, open source software, trade secrets, and sabotage. For example, research and report on the effects of unethical programming practices on a business. (TN Reading 1, 2; TN Writing 7)

Programming Skills

4) Differentiate between system-level and application solutions, and identify an appropriate code-based strategy to solve a given problem. For example, given a file management problem, determine when a command-line script will be more efficient than a high-level program solution. (TN Reading 4, 5; TN Math N-Q, A-SSE, F-IF)

5) Apply the system management tools present in a programming development environment to:
   a. Select the most appropriate programming language for the task at hand
   b. Develop syntactically correct program code using current best practices and emerging classes of development techniques
   c. Use a compiler to interpret the source code and produce executable program code

6) In the process of developing and implementing programming solutions, develop strategies that work within the constraints of major operating system fundamentals, such as:
   a. Security protocols and procedures for accessing files and folders
   b. File management syntax requirements, including but not limited to creating, naming, organizing, copying, moving, and deleting files
   c. File naming conventions, as they apply across multiple software applications and file types.

7) Write pseudocode and construct a flowchart for a process before starting to develop the program code. For example, code and flowchart a simple process that takes an integer and report whether it is odd or even.

8) Organize and develop a plan to acquire and manage the data values for a process, including the following:
   a. Data types, such as string, numeric, character, integer, and date
   b. Program variable names
   c. Variables and constants
   d. Arrays (at least one- and two-dimensional), subscripts
   e. Input from files and user responses
   f. Output to files and reports

9) Using a programming language specified by the instructor, convert the pseudocode for a selected process to program code, incorporating at least three of the following structures, the need for which will be dictated by the assigned problem(s) and process(es). The resulting code design can be event-driven, object-oriented, or procedural.
   a. Operations and functions (user-defined and/or library)
   b. Repetition (loops)
   c. Decision (if…else, case)
   d. Recursion

10) Verify the correct operation of the resulting program code with several test cases:
   a. All valid values
   b. Error trapping of invalid values
   c. Error trapping of invalid program operation
   d. Troubleshooting/remedying program problems

Project Planning and Quality Assurance

11) Compile the necessary documentation to understand the nature of a computer programming problem and the customer/client specifications for the request and summarize in an informational text. This will include evidence of the scope of the problem, its attendant input and output information, the required system processing, and the software specifications involved. (TN Reading 1, 2, 3; TN Writing 2, 8)

12) Analyze a given problem and develop a coherent strategy in the form of a project plan to meet the customer/client's need. The plan will include, but will not be limited to, defining the project scope as addressed by the problem documentation, identifying software development and implementation issues, timeline and benchmarks for design, and addressing issues associated with software maintenance and life cycle. (TN Reading 1, 2; TN Writing 2, 8)

13) In the software development process, articulate the nature of the program designs by creating documentation that addresses topics including but not limited to:
   a. The procedural, object-oriented, event-driven, or other nature of the various portions of the resulting application
   b. The data structures used for inputs, outputs, and internal manipulations
   c. The algorithms and guiding formulas used
   d. Constraints on accurate operation and results
   e. Modular designs that enable portability
   f. Interface details that permit ready maintenance and upkeep
   (TN Reading 6; TN Writing 2, 6)

14) Apply principles of quality assurance during application development to certify bug tracking, audit trails, testing results, and other quality considerations. Annotate each quality assurance task with evidence from best practices endorsed by industry or research. (TN Reading 3, 6; TN Writing 7)

15) Document the security risks associated with new applications and evaluate the severity of the risk involved in each, including but not limited to:
   a. Identifying threats to information systems facilities, data communications systems, and other applications
   b. Adhering to federal and state legislation pertaining to computer crime, fraud, and abuse
   c. Providing means for preserving confidentiality and encryption of sensitive data
   d. Detailing steps to recover from routine errors or catastrophic failures, such as might be caused by a malicious computer virus
   (TN Reading 8; TN Writing 1, 4)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, 9 and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 9 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity, Algebra, and Functions (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

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Programming & Logic II

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6099
Prerequisite(s):	*Programming & Logic I* (6098)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses.
Programs of Study and Sequence:	This is the third course in the *Programming & Software Development* program of study.
Aligned Student Organization(s):	Skills USA: whttp://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	037, 041, 055, 056, 057, 152, 153, 203, 204, 311, 434, 435, 436, 474, 475, 476, 595, 740, 742
Required Teacher Certifications/Training:	Endorsements 474, 475, 476 require the equivalent of twelve semester hours of computer course work including at least six hours of programming language.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

Programming & Logic II challenges students to develop advanced skills in problem analysis, construction of algorithms, and computer implementation of algorithms as they work on programming projects of increased complexity. In so doing, they develop key skills of discernment and judgment as they must

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choose from among many languages, development environments, and strategies for the program life cycle. Course content is reinforced through numerous short- and long-term programming projects, accomplished both individually and in small groups. These projects are meant to hone the discipline and logical thinking skills necessary to craft error-free syntax for the writing and testing of programs. Upon completion of this course, proficient students will demonstrate an understanding of object-oriented programming language using high-level languages such as FOCUS, Python, or SAS. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the third course in *Programming & Software Development* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Software Development Environments

1) Evaluate at least two software development environments (SDEs) that are tailored to different programming languages on the basis of their suitability for a range of programming tasks, ease of use, and how ubiquitous they are within the IT community. Document in an oral presentation the similarities and differences between the two, and the features that lend themselves to the chosen programming languages. For example, students assigned to code a basic database interface can compare the benefits and features of a freeware SDE such as *JDeveloper* and a commercial SDE like *Microsoft Visual Studio*. ~~(TN Reading 1, 2, 5, 7, 9; TN Writing 2, 4, 6, 8, 9)~~

2) Investigate the typical process around creating new software within a software development environment. Describe and furnish examples of the steps taken within the SDE to guarantee reliable output, from prototyping and authoring to deployment and debugging. ~~(TN Reading 2, 3; TN Writing 2, 7, 8)~~

3) Administer the process of creating new software within a software development environment to manage the prototyping, authoring, revising, compiling, testing, deploying, and debugging of student-developed software. For example, for an object-oriented payroll program assignment (retrieving file data to produce a run of paychecks and paystubs for a small business), perform and document the steps taken within the SDE to ensure the reliable and accurate output of paychecks. ~~(TN Reading 3, 4, 5; TN Writing 6, 7)~~

Software Development Life Cycle

4) Synthesize information from a range of sources (including original tests and simulations) to critique the features of different software development life cycles (agile, iterative, and sequential types). Using domain-specific terminology, explain to a technical audience the distinguishing features of each that make one more appropriate for certain types of applications. ~~(TN Reading 2, 4, 9; TN Writing 2, 4, 9)~~

5) For a selected assignment or project involving the development of original software, choose and defend a strategy to follow for the program's development life cycle. At the completion of the

assignment, offer recommendations for other environments and alternative strategies that could improve the development process. (TN Reading 3, 6, 8, 9; TN Writing 1, 4, 7, 9)

6) Research common and best-practice techniques in programming analysis, design, and implementation. Drawing on model practices used by businesses and industry, employ analysis, design, and implementation techniques to satisfy a programming need, using an appropriate software lifecycle model. (TN Reading 2, 3, 5, 6; TN Writing 6, 8)

7) Employ a requirement management tool during a program's development life cycle, documenting the evolving versions, storage attributes, system elements, status tracking, and access permissions afforded by the tool, as well as the successful attainment of the project vision. (TN Reading 3, 4, 5, 7, 9; TN Writing 4, 6, 9)

Designing Computer Applications

8) For a given programming assignment, choose and defend a programming language with regard to the language's capabilities and suitability to task, availability, portability, maintainability, and cost. (TN Reading 3, 4, 5; TN Writing 1, 4)

9) For the assignment outlined in standard 8, identify the method of data processing most appropriate for the task (e.g., batch, interactive, or event-driven). For example, a weekly payroll application would handle its data differently (i.e., batch processing) than a web-based search engine (i.e., interactive processing), and still differently than a microprocessor control program for a washing machine (i.e., event driven). (TN Reading 3, 4, 5, 6, 8)

10) Define the specifications of the data management plan, including variables (naming, scope, and types), validation measures (to protect the data from corruption), and data handling (storing, input/output, and back-up). For example, programs handling historical temperature data would be best suited to floating point values stored in multidimensional arrays, written to permanent storage, and displayed with limited precision. (TN Reading 3, 4, 5)

11) For a selected programming assignment involving an object-oriented language, design and define the classes, objects, properties, methods, and inheritance structures prior to the start of the development cycle. Revise the plan (modifications, additions, and subtractions) as needed throughout the development cycle. (TN Reading 2, 3, 4, 5, 7; TN Writing 5)

Coding Computer Applications

12) For selected programming assignments, create, edit, and improve documentation for technical support intended for fellow programmers, including within the program code itself as well as within supplemental documents. For example, for a lawn sprinkler system microcontroller, the technical documentation would define the variables, functions and subroutines, and the critical events. (TN Reading 1, 3, 4, 5, 7; TN CSS Writing 2, 4, 5, 6, 10)

13) For selected programming assignments, create, edit, and improve end-user documentation. End-user documentation would include how to interact with the user interface, the capabilities and limitations of the system, and the required conditions for successful operation. (TN Reading 1, 3, 4, 5, 7; TN CSS Writing 2, 4, 5, 6, 10)

14) Incorporate structured, object-oriented, and event-driven programming techniques that employ sequence, selection, and/or repetition (loops) to solve programming projects. (TN Reading 3, 5, 7; TN Writing 6, 7)

15) For each programming task, consider and defend the choice of various programming approaches (such as data-driven or event-driven, top-down or bottom-up), citing examples from the syntax illustrating the chosen approach. (TN Reading 3; TN Writing 1, 4, 7, 8)

16) Design and develop an app for a mobile computing device, using an online programming interface, such as AppMakr, BuzzTouch, Appsbar, PhoneGap, or AppYet. (TN Reading 2, 3, 4, 7; TN Writing 6, 7)

Software Testing Procedures & Quality Assurance

17) During the development, testing, and deployment of a new program, implement checks for data and procedure accuracy, correctness, currency, and relevance, making and documenting revisions where justified. (TN Reading 3; TN Writing 2, 4, 5, 6, 7, 10)

18) Analyze the code written by another programmer to create a flowchart, suggesting points of confusion or generality in the program that could become problematic in future revisions. Cite specific examples in the code to support recommendations. (TN Reading 1, 2, 3, 4, 5, 6, 7, 8; TN Writing 1, 4, 6)

19) Conduct quality testing of program code, striving for satisfactory results at four levels or perspectives:
    a) Unit (component/module level verifications)
    b) Integration (verifying the interfaces between components, adding one at a time)
    c) System (verifying that the whole package meets the requirements and specifications without corrupting other systems)
    d) Acceptance (customer satisfaction)
    (TN Reading 2, 3, 4, 5, 6)

Project Management

20) Design, manage, and develop a course-long programming project pre-approved by the instructor. The project will embody a variety of strategies and resources taught in this course, and require periodic reviews, status reports, and final project presentation. Use a software development environment to manage, document, test, deploy, and maintain the resources and assets of the finished project. (TN Reading 1, 2, 3, 4, 5, 6, 7, 8; TN Writing 1, 2, 4, 5, 6, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Programming & Software Development Practicum

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	5908
Prerequisite(s):	*Algebra I* (0842, 3012) and *Programming & Logic II* (6099)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses.
Programs of Study and Sequence:	This is the capstone course in the *Programming & Software Development* program of study.
Aligned Student Organization(s):	Skills USA: whttp://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	See https://tn.gov/education/article/cte-cluster-information-technology
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	037, 041, 055, 056, 057, 152, 153, 203, 204, 311, 434, 435, 436, 474, 475, 476, 595, 740, 742
Required Teacher Certifications/Training:	Endorsements 474, 475, 476 require the equivalent of twelve semester hours of computer course work including at least six hours of programming language. If students are assigned in work-based learning settings, teachers must attend WBL training and earn the WBL Certificate provided by the Tennessee Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Approved January 30, 2015; Amended April 15, 2016

Course Description

Programming & Software Development Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous *Programming & Software Development* courses toward the completion of an in-depth project with fellow team members. Students who have progressed to this level in the program of study take on more responsibilities for producing independent work and managing processes involved in the planning, designing, refinement, and production of original software applications. The course is designed to allow students to choose their specific application of interest, be it the development of a mobile application (app), an animation package, a game or other educational tool, or any other approved program that requires coding and development skills. Upon completion of the practicum, proficient students will be prepared for postsecondary study and career advancement in programming and software development, and will be equipped to market their finished product should they choose. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.~~*

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Programming & Software Development* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Programming & Software Development Career Planning

1) Research a company or organization that employs computer programmers or specializes in software design and development solutions. Companies could range from large software developers, to niche organizations that retain programmers on staff to serve their particular clients' needs. For the chosen company, cite specific textual evidence from the company's literature, as well as available press coverage (if available) to summarize:
   a. The mission and history of the organization
   b. Headquarters and organizational structure
   c. Products or services provided
   d. Credentials required for employment and how they are obtained and maintained
   e. Policies and procedures

      f.   Reports, newsletters, and other documents published by the organization

      g.   Website and contact information

~~(TN Reading 1, 2; TN Writing 7)~~

2) Analyze the requirements and qualifications for various programming and development job postings identified from specific company websites or online metasearch engines. Gather information from multiple sources, such as sample resumes, interviews with professionals, and job boards, to determine effective strategies for realizing career goals. Create a personal resume modeled after elements based on the findings above, then complete an authentic job application as part of a career search or work-based learning experience. ~~(TN Reading 4, 9; TN Writing 4, 7, 8)~~

3) Participate in a mock interview. Prior to the interview, research tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. ~~(TN Reading 2; TN Writing 2, 4, 7, 9)~~

Professional Ethics and Legal Responsibilities

4) Investigate current issues surrounding the use of software applications to collect and track user data. Explore a range of arguments concerning privacy rights as they relate to the mining of personal data; determine when it is ethical and legal to collect data for profit versus for security purposes. Advance an original argument that debates the pros and cons and summarizes the potential ramifications for clients, users, the public, and one's own personal reputation, drawing on evidence gathered from news media, company policies, and state and federal laws. ~~(TN Reading 1, 2, 4, 8, 9; TN Writing 1, 4, 6, 7)~~

5) Research a case study involving an ethical issue related to intellectual property rights. Examine a variety of perspectives surrounding the issue, then develop an original analysis explaining the impact of the issue on those involved, using persuasive language and citing evidence from the research. Potential issues include copyright infringement, piracy, plagiarism, art licensing, creative commons, and the state/federal laws that govern them. ~~(TN Reading 1, 2; TN Writing 1, 4, 6, 7)~~

Course Project

6) In teams or individually, develop a written proposal for an original program or software application that involves advanced refinement and transfer of skills and knowledge acquired in previous *Programming & Software Development* courses. The proposal should be narrative in nature but supplemented by relevant data and graphic illustrations as needed, such as flowcharts of development processes and diagrams or sketches of what the end product would resemble. Sample projects include: developing a mobile app; designing an animation package or plug-in; writing an original game program; or any other programming-based project. Present the proposal to the class, and continually revise based on feedback from peers. ~~(TN Reading 3, 7, 9; TN Writing 4, 5, 6, 7)~~

7) Throughout the design and development process, develop supplementary documents, presentations, and strategies to support the production and promotion of the program, app, or

product. Identify the target market for the product, and devise a tentative plan to inform, promote, and convince prospective users of the product's functions and value. Research marketing plan templates and sample presentations, and synthesize information to produce an original plan outlining how the team intends to market the product once it is finished. (TN Reading 3, 7, 9; TN Writing 4, 5, 6, 7)

8) Apply coding skills learned in previous courses to novel contexts and development environments. For example, develop skills in an emerging technology that would support the completion of the course project, or learn a new programming language not previously studied in order to enhance the functionality of the product. (TN Writing 6, 7)

Advanced Troubleshooting, Critiquing, & Problem Solving

9) In the course of developing the project, regularly test for functionality, compatibility, and other design aspects related to user friendliness. Conduct and document the proper code validation to resolve errors encountered in the design process. (TN Reading 3, 8; TN Writing 6, 7)

10) Analyze the code written by another team member or peer and create a flowchart for suggesting changes to improve functionality. Cite specific examples in the code to support recommendations. (TN Reading 1, 2, 3, 4, 5, 6, 7, 8; TN Writing 1, 4, 6)

11) Research and test for potential security threats related to the intended uses of the app, program, or product. For example, if a mobile app is developed, determine the most common security threats and identify areas of vulnerability in the product that could be remedied by adjusting for the proper code, patching, or system update. If possible, develop and incorporate security measures into the final product to ensure user safety. (TN Reading 2, 4)

Portfolio

12) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the design process, as outlined by the instructor. The following documents will reside in the student's portfolio:
    a. Personal code of ethics
    b. Career and professional development plan
    c. Resume
    d. Project proposal with supporting documents
    e. List of responsibilities undertaken through the course
    f. Examples of visual materials developed and used during the course (such as drawings, models, presentation slides, videos, and demonstrations)
    g. Marketing plan
    h. Description of technology used, with examples if appropriate
    i. Periodic journal entries reflecting on tasks and activities
    j. Feedback from instructor and/or supervisor based on observations
    (TN Reading 7; TN Writing 4, 5, 6)

Communication of Project Results

13) Produce technical reports highlighting the purpose, content, and use of the app, program, and product developed for this course. Cite evidence from multiple authoritative sources in order to justify design and development decisions and maximize the user experience. Incorporate supporting graphics, sketches, and data as needed to summarize the technical specifications of the product. (TN Reading 1, 2, 3, 4, 5, 7, 8, 9; TN Writing 1, 5, 6, 7, 8, 9)

14) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, flowcharts, and/or market data on the target users. Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Computer Systems

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6094
Prerequisite(s):	*Information Technology Foundations* (6095), *Algebra I* (0842, 3102)
Credit:	1
Grade Level:	10-11
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the second course in the *Networking Systems* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CompTIA A+
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	153, 311, 435, 436, 475, 476, 582, 595, 740
Required Teacher Certifications/Training:	A+, NetPlus, CIW, or CISCO Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

Computer Systems is an intermediate course designed to prepare students with work-related skills and aligned certification in the information technology industry. Content provides students the opportunity to acquire knowledge in both theory and practical applications pertaining to hardware, operating systems, safe mode, command prompt, security, networking, printers, peripheral devices, laptops,

Approved January 30, 2015; Amended April 15, 2016

mobile devices, troubleshooting, and customer service management. Upon completion of the course, proficient students will have acquired skills and knowledge to install, configure, and maintain computer systems. Students who are proficient in this course will be eligible to pursue the IT industry-standard credential, CompTIA's A+ certification. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the second course in the *Networking Systems* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Internet safety, (4) Occupational Safety and Health Administration (OSHA) guidelines, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. ~~(TN Reading 3, 4)~~

Career Exploration

3) Explore the types of technical certifications recognized in the information technology (IT) industry. Write a brief paper that distinguishes between vendor neutral and vendor specific certifications, providing examples of each. Explain why earning technical certification is advantageous to IT professionals. Cite evidence from technical literature and industry standards to support claims. ~~(TN Reading 1, 2, 4; TN Writing 2, 4)~~

4) Locate and access the Computer Technology Industry Association (CompTIA) website and analyze its structure, policies, and requirements for CompTIA A+ certification. Identify what steps are required to obtain the certification, and explain how to prepare for the examination. ~~(TN Reading 2, 3, 4)~~

Hardware

5) Research the following storage devices and backup media. Create a table or other graphic organizer that lists examples of each device and details their purpose, characteristics, and proper maintenance. Demonstrate proper installation and configuration of each device while using the appropriate media.
    a. Optical drives
    b. Combo drives and burners
    c. Connection types

  d. Hard drives
  e. Solid state / flash drives
  f. RAID types
  g. Floppy drive
  h. Tape drive
  i. Media capacity
 (TN Reading 2, 4, 8; TN Writing 2, 4)

6) Identify and explain the following motherboard components. Citing specific examples, write a brief paper differentiating between the components and describing the purpose, properties, and characteristics of each.
  a. Expansion slots
  b. RAM slots
  c. CPU sockets
  d. Chipsets
  e. Jumpers
  f. Power connections and types
  g. Fan connectors
  h. Front panel connectors
  i. Bus speeds
 (TN Reading 2, 4; TN Writing 2, 4)

7) Given an assignment with defined hardware specifications, identify the appropriate power supply. Noting the following technical components, write a text explaining the various types of power supply that were considered. Citing specific evidence, explain the characteristics of each and how the final selection was determined. Install the appropriate power supply.
  a. Connector types and their voltages
  b. Specifications (e.g., wattage, size, number of connectors, etc.)
  c. Dual voltage options
 (TN Reading 2, 3, 4; TN Writing 1, 4)

8) Explore various types of central processing units (CPU). Describe the following characteristics of the CPU types. Identify appropriate cooling methods (e.g., heat sink, fans, thermal paste, liquid-based) for each type discussed and justify the selection with supporting evidence.
  a. Speeds
  b. Cores
  c. Cache size/type
  d. Hyperthreading
  e. Virtualization support
  f. Architecture (32-bit vs 64-bit)
  g. Integrated GPU
 (TN Reading 2, 4; TN Writing 1, 4)

9) Investigate the following memory types. Create a table or other graphic organizer that describes, compares, and contrasts each type. Explain the memory compatibility and speed, as well as the appropriate application of each memory type. Cite evidence supporting each application prescribed.
  a. DDR

b. DDR2
c. DDR3
d. SDRAM
e. SODIMM
f. RAMBUS
g. DIMM
h. Parity vs. non-parity
i. ECC vs. non ECC
j. RAM configurations
k. Single sided vs. double sided
(TN Reading 2, 4, 7; TN Writing 4)

Operating Systems

10) Research the features and requirements of Microsoft operating systems. Write a brief paper that compares and contrasts the operating systems. Drawing on multiple resources, explain why it is important to know this information when installing and configuring an operating system. (TN Reading 3, 4, 5; TN Writing 2, 4)

11) Identify and explain various alternatives to install and configure an operating system. For a given assignment, install and configure an operating system by selecting the most appropriate method. Upon completion of the work, write an explanation and justify the actions by citing supporting evidence from technical manuals and industry standards. The explanation should include, but is not limited to, information on the following:
    a. Boot methods (e.g., USB, CD-ROM, DVD, PXE)
    b. Type of installations (e.g., creating image, unattended installation, upgrade, multiboot, etc.)
    c. Partitioning (e.g., dynamic, basic, primary, extended, logical)
    d. File system types/formatting (e.g., FAT, FAT32, NTFS, CDFS, quick format vs. full format)
    e. Loading alternate third party drivers
    f. Workgroup vs. Domain group
    g. Driver installation
    h. Factory recovery partition
    (TN Reading 2, 3, 4; TN Writing 2, 4)

12) Demonstrate an understanding of how to apply the following command line tools to identify problems with networking and operating systems. For a given assignment, follow the multistep process to execute an appropriate command and justify why it was selected to perform a specific action.
    a. Networking (e.g., PING, TRACERT, NETSTAT, IPCONFIG, NET, NSLOOKUP, NBTSTAT)
    b. Operating system (e.g., TASKKILL, BOOTREC, SHUTDOWN, TASKLIST, MD, RD, CD, DEL, FORMAT, COPY, XCOPY, ROBOCOPY, DISKPART, SFC, CHKDSK)
    (TN Reading 2, 3, 4)
13) Demonstrate the proper selection and use of the following operating system features and tools. For a given assignment, explain the selection of the tools and the results.
    a. Administrative (e.g., local security policy, Windows firewall, performance monitor, etc.)
    b. MSCONFIG (e.g., general, boot, services, startup, and tools)
    c. Task Manager (e.g., applications, processes, performance, networking, users)

  d. Disk management (e.g., drive status, mounting, extending partitions, splitting, adding drives, adding arrays, etc.)

  e. Command line utilities (e.g., MSCONFIG, REGEDIT, CMD, SERVICES.MSC, MMC, MSTSC, NOTEPAD, EXPLORER, MSINFO32, DXDIAG)

(TN Reading 2, 3, 4)

14) Demonstrate the proper application of the following control panel utilities that are common to all Microsoft operating systems, as well as those specific to unique Windows operating systems. Write a text describing the utilities and explain the results of the various applications.

  a. Internet options (e.g., connections, security, general, privacy, programs, advanced)

  b. Display/Display settings

  c. User accounts

  d. Folder options (e.g., view hidden files, hide extensions, general options, view options)

  e. System (e.g., performance, remote settings, system protection)

  f. Windows firewall

  g. Power options (e.g., hibernate, power plans, sleep/suspend, standby)

(TN Reading 2, 3, 4; TN Writing 2, 4)

15) Identify and describe the differences among the following basic operating system security settings. Write a brief paper that discusses when each setting is most applicable. Provide specific examples to support the claims.

  a. User and groups (e.g., administrator, power user, guest, standard user)

  b. NTFS vs. share permissions (e.g., allow vs. deny, moving vs. copying file folders and files, file attributes)

  c. Shared files and folders (e.g., administrative vs. local folders, permission propagation, inheritance)

  d. System files and folders

  e. User authentication (e.g., single sign-on)

(TN Reading 2, 3, 4; TN Writing 1, 4)

Safe Mode and Command Prompt

16) Demonstrate an understanding and application of safe mode versus the command prompt. Describe specific scenarios when the safe mode should be used to solve a problem, as well as provide specific examples of the types of tasks that can be completed using the command prompt. Also, describe when the safe mode should be used with the command prompt. For example, safe mode can be used to solve problems with corrupted and/or malicious applications. (TN Reading 2, 3, 4)

Preventative Maintenance Procedures

17) Create and execute a plan for preventative maintenance for a computer system. The plan should include a schedule and description of the following procedures. Write a justification that explains to a client why preventative maintenance is important.

  a. Backup

  b. Check disk

  c. Defragmentation

  d. Windows updates

e. Patch management
f. Driver/firmware updates
g. Antivirus updates
(TN Reading 2, 3, 4; TN Writing 1, 4)

Security

18) Research and describe the most common security threats to computer systems, such as social engineering, malware, phishing, viruses, etc. Investigate and distinguish among the following common prevention methods to secure a computer system. For a given scenario, identify the most applicable best practice to secure a workstation as well as describe methods for data destruction and disposal. Implement these practices and write a justification for each scenario solution. Provide supporting evidence for each solution, drawing on technical texts and industry standards. Prevention methods include:
   a. Physical security (e.g., lock doors, tailgating, biometrics, badges, key fobs, retinal, etc.)
   b. Digital security (e.g., antivirus, firewalls, antispyware, user authentication, etc.)
   c. User education
   d. Principles of least privilege
   (TN Reading 2, 4; TN Writing 1, 4, 6, 7)

Networking

19) Identify and describe the following fundamental principles of a small office / home office (SOHO) network (wireless and wired router).
   a. MAC filtering
   b. Channels (1 -11)
   c. Port forwarding, port triggering
   d. SSID broadcase (on/off)
   e. Wireless encryption
   f. Firewall
   g. DHCP (on/off)
   h. DMZ
   Create and execute a plan to configure, install, and upgrade a SOHO network. Upon completion of the work, write an explanation and justify the actions by citing supporting evidence from technical manuals and industry standards. (TN Reading 2, 3, 4; TN Writing 1, 4, 8, 9)

20) Given scenarios for both wired and wireless small office home office (SOHO) networks, develop and execute an appropriate plan to secure the network. The plan should address, but is not limited, to the following:
   a. Wireless network
      • Change default user-names and passwords
      • Changing SSID
      • Setting encryption
      • Disabling SSID broadcast
      • Enable MAC filtering
      • Antenna access point placement
      • Radio power levels

- Assign static IP addresses
  b. Wired network
    - Change default usernames and passwords
    - Enable MAC filtering
    - Assign static IP addresses
    - Disabling ports
    - Physical security

Justify the plan with evidence supported by technical literature and industry standards. ~~(TN Reading 2, 3, 4)~~

Servers

21) Create a document that explains the purpose and components of a server. Include descriptions of the various types of servers (e.g., file, email, web, etc.) and the hardware specifications required to support each type. Using multiple resources, cite evidence to support the information identified and discussed. For example, a file server used in a home office will not require as much RAM (random access memory) as one that supports a large office building. ~~(TN Reading 2, 4, 7; TN Writing 2, 4)~~

Printers and Peripheral Devices

22) Explore and distinguish among the following printer types. Briefly describe their similarities and differences, as well as the imaging process required for applicable printer types. Explain why it is important to know this information when installing and configuring printers.
    a. Laser
    b. Inkjet
    c. Thermal
    d. Impact
    ~~(TN Reading 2, 3, 4)~~

23) For a given assignment, write and execute a plan to install, configure, and maintain a printer that is most appropriate for each of the following example situations. Explain and justify the selection with supporting evidence from technical manuals and computer systems texts.
    a. Installing and configuring onto a specific operating system
    b. Print device sharing (e.g., wired, wireless, printer hardware print server)
    c. Printer sharing (e.g., via operating system settings)
    ~~(TN Reading 2, 3, 4; TN Writing 1, 4, 7)~~

24) Distinguish among and describe the following peripheral devices commonly found in computer systems. Install and configure these devices conforming to technical manuals and industry standards.
    a. Input devices (e.g., mouse, keyboard, touch screen, scanner, barcode reader, etc.)
    b. Multimedia devices (e.g., digital cameras, microphone, webcam, camcorder, MIDI enabled devices)
    c. Output devices (e.g., printers, speakers, display devices)
    ~~(TN Reading 2, 3, 4, 7)~~

Laptops

25) Identify and explain the following laptop components. Citing specific examples, write a brief paper differentiating between the components and describing the purpose, properties, characteristics, and proper maintenance of each. Demonstrate proper installation and configuration of each component. For example, replace an optical drive in a laptop.
   a. Expansion options (e.g., express card, PCMIA, SODIMM, flash)
   b. Keyboard
   c. Hard drive
   d. Memory
   e. Optical drive
   f. Wireless card
   g. Mini-PCIe
   h. Screen
   i. DC jack
   j. Battery
   k. Touchpad
   l. Plastics
   m. Speaker
   n. System board
   o. CPU

   (TN Reading 2, 4; TN Writing 2, 4)

26) Compare and contrast the following components within the display of a laptop and the laptop features. Citing specific examples, write a brief paper differentiating between the components and describing the purpose and characteristics of each. Demonstrate the execution of the features. For example, turn on the keyboard back light.
   a. Components:
      • Types (e.g., LCD, LED, OLED, plasma)
      • Wi-Fi antenna connector/placement
      • Inverter
      • Backlight
   b. Features
      • Special key functions
      • Docking station vs. port replicator
      • Physical laptop lock and cable lock

   (TN Reading 4; TN Writing 2, 4)

Mobile Devices

27) Explore the following basic features of mobile operating systems. Write a brief paper that compares and contrasts these systems on the following features. Drawing on multiple resources, explain why it is important to know this information when installing and configuring an operating system.
   a. Open source vs. closed source/vendor specific
   b. App source (app store and market)
   c. Screen orientation (accelerometer/gyroscope)
   d. Screen calibration
   e. GPS and geotracking

   (TN Reading 4, 7; TN Writing 2, 4)

28) Research and describe the most common security threats related to mobile devices. Investigate and distinguish among the following common prevention methods to secure a mobile device.
   a. Passcode locks

  b. Remote wipes
  c. Locator applications
  d. Remote backup applications
  e. Failed login attempts restrictions
  f. Antivirus
  g. Patching/OS updates
 (TN Reading 2, 4)

Troubleshooting

29) Investigate a simple problem and create a flowchart, or other graphic illustration, that explains the following steps representing a general troubleshooting theory.
  a. Gather information from the user or operator and back up data
  b. Verify the problem exists
  c. Isolate the cause of the problem and generate alternative solutions
  d. Plan a solution and resolve the problem
  e. Verify that the problem was resolved and prevent a future occurrence
  f. Document findings, resolution, and preventative maintenance plan
 Compare and contrast the findings, resolution, and maintenance plan with those of other classmates. Provide supporting evidence for any selections that differ from classmates, and work together to come to a consensus on a resolution. (TN Reading 2, 3, 4; TN Writing 1, 4)

30) Given a problem related to the following components, follow the troubleshooting theory using appropriate tools. Identify the problem and document the findings and resolution. Include an explanation of the common symptoms, diagnostic procedures, and specific tools used that led to the problem resolution.
  a. Motherboards, RAM, CPU, and power
  b. Hard drives and RAID arrays
  c. Video and display
  d. Wired and wireless networks
  e. Client-side network connectivity
  f. Operating systems
  g. Security issues
  h. Laptops
  i. Printers
 (TN Reading 3, 4, 9; TN Writing 1, 4)

Customer Service and Client Relations

31) Compare and contrast the processes of servicing customers on the phone, online, on-site, or in a shop. Based on the findings, write a brief description of how to service a customer in each of these situations. Include the following in the description:
  a. Identify questions that a customer should be asked to identify his/her problem
  b. Approaches to dealing with difficult customers
  c. When it is appropriate to escalate a problem to a senior support team member
  d. How to document the services provided
 (TN Reading 2, 3, 4, 6; TN Writing 2, 4)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Networking

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6097
Prerequisite(s):	*Computer Systems* (6094), *Algebra I* (0842, 3102)
Credit:	1
Grade Level:	11-12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the third course in the *Networking Systems* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CompTIA Network+
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	153, 311, 435, 436, 475, 476, 582, 595, 740
Required Teacher Certifications/Training:	A+, NetPlus, CIW, or CISCO Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

Networking is an advanced course designed to emphasize the conceptual and practical skills necessary to design, manage, and diagnose network hardware and software. Upon completion of this course, proficient students will identify types of networks, understand the layers of the open systems interconnection (OSI) model, prevent security risks, and apply troubleshooting theory to the successful execution of networking tasks. Course content covers transmission control protocol, internet protocol,

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wired and wireless topologies, switching and routing, network hardware, wireless networking, and network operating systems (NOS). Upon completion of this course, proficient students will be prepared to sit for the CompTIA Network+ exam. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

Program of Study Application

This is the third course in the *Networking Systems* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Internet safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Complete safety test with 100 percent accuracy. (TN Reading 3, 4, 6)

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. (TN Reading 3, 4)

Career Exploration

3) Locate and access the Computer Technology Industry Association (CompTIA) website and analyze its structure, policies, and requirements for CompTIA Network+ certification. Explain what steps are required to obtain the certification, methods to prepare for the examination, and how it can be a stepping stone to more advanced certifications. (TN Reading 2, 3, 4)

4) Research the following networking standards organizations and write an informative paper explaining the industry standards that are managed by each. Describe why these standards are important and how they influence the work of a network administrator or other IT professional.
   a. American National Standards Institute
   b. Electronic Industries Alliance and Telecommunications Industry Association
   c. Institute of Electrical and Electronics Engineers
   d. International Organization for Standardization
   e. International Telecommunication Union
   f. Internet Society
   g. Internet Assigned Numbers Authority
   h. Internet Corporation for Assigned Names and Numbers
   (TN Reading 1, 2, 4; TN Writing 2, 4, 7)

Types of Networks

5) Define the term "network," define and describe the necessary features and components of a network, and differentiate between different network types. Using graphic illustrations, or other diagrams, identify and describe the following types of networks, outlining the features that distinguish each network from the others and effectively diagraming the flow of information in each.
   - a. Peer-to-peer networks
   - b. Client/server networks
   - c. Local area networks (LAN)
   - d. Metropolitan area networks (MAN)
   - e. Wide area networks (WAN)

   ~~(TN Reading 1, 4, 7; TN Writing 2, 4)~~

6) Describe the following functions provided by a network. Distinguish between these network services in a large office versus an office with few users, providing specific examples.
   - a. File and print services
   - b. Access services
   - c. Communication services
   - d. Internet services
   - e. Management services

   ~~(TN Reading 2, 3, 4; TN Writing 4, 8)~~

Open Systems Interconnection Model (OSI) Model

7) Create and use diagrams to explain the Open Systems Interconnection (OSI) Model and the flow of data through it. Define the functions and identify the associated hardware components of the OSI Model's following seven layers. For example, explain how each layer interacts to ensure that data arrives in the correct place without errors.
   - a. Application
   - b. Presentation
   - c. Session
   - d. Transport
   - e. Network
   - f. Data Link
   - g. Physical

   ~~(TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4)~~

Data Transmission

8) Identify and describe a range of standard cable types (e.g., coaxial cable, shielded twisted pair, unshielded twisted pair, single-mode fiber, multimode fiber, serial, plenum, and non-plenum), comparing and contrasting their characteristics and properties and differentiating between them accurately. Explain why it is necessary to consider the following properties when selecting and installing the appropriate cables for a networking task, and why these decisions must conform to industry standards. For a given task and environment, make a recommendation about an appropriate cable type and defend the recommendation with specific evidence and reasoning.

a. Transmission speeds
b. Distance
c. Duplex
d. Noise immunity (e.g., security, electromagnetic interference (EMI))
e. Frequency
(TN Reading 2, 3, 4, 7; TN Writing 1, 4)

Transmission Control Protocol (TCP)/Internet Protocol (IP)

9) Research and identify the common subprotocols associated with transmission control protocol (TCP) and internet protocol. Using a combination of text and graphic illustrations, explain their functions and how they correlate to the layers of the open systems connection (OSI) model. Examples of subprotocols include, but are not limited to: hypertext transfer protocol (HTTP), user diagram protocol (UDP), internet control message protocol (ICMP), internet group management protocol (IGMP), address resolution protocol (ARP), domain name system (DNS), network time protocol (NTP), file transfer protocol (FTP), and trivial file transfer protocol (TFTP). (TN Reading 2, 3, 4, 5, 9; TN Writing 2, 4)

10) Describe the following address formats: IPv6, IPv4, and MAC. Using the advantages and disadvantages as supporting evidence, identify and explain the application of each format. (TN Reading 2, 4)

Topologies

11) Define each of the following physical network topologies, and draw diagrams to distinguish among the layouts. Include examples of the most effective applications, as well as identify the advantages and disadvantages of each topology.
a. Star
b. Mesh
c. Bus
d. Ring
e. Point to point
f. Point to multipoint
g. Hybrid
(TN Reading 2, 3, 4; TN Writing 2, 4)

12) Compare and contrast logical network topologies to physical network topologies. Explain how these two types of topologies differ. Identify the common logical network topologies and describe their characteristics. Provide examples demonstrating how logical network topologies are useful in troubleshooting. (TN Reading 2, 3, 4, 9)

Switching and Routing

13) Define switching and detail the role that it occupies in a logical network topology. Describe the three types of switching (circuit, message, and packet) and identify the specific details that distinguish how each method establishes paths between nodes. (TN Reading 2, 4)

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14) Define routing and explain why a router is protocol dependent. Identify and list the properties of a router and describe its basic functions, citing examples found in informational texts. (TN Reading 2, 4, 7; TN Writing 2, 4, 8)

15) Write descriptive text that outlines the process used to determine the most efficient path (e.g., route) for data to flow across a network. Identify and describe that variables the influence the best path, including the following most common routing protocols.
    a. Link-state: open shortest path first (OSPF), intermediate system to intermediate system (IS-IS)
    b. Distance-vector: routing information protocol (RIP), routing information protocol version 2 (RIPv2), border gateway protocol (BGP)
    c. Hybrid: enhanced interior gateway routing protocol (EIGRP)
    (TN Reading 2, 3, 4; TN Writing 2, 4)

Network Hardware

16) Research the following types of network interface cards (NICs). Create a table or other graphic organizer that lists examples and characteristics of NICs, as well as steps to selecting the appropriate NIC. Demonstrate proper installation and configuration of each device, attending to appropriate measurements and units. Summarize the multistep procedure to install and configure the various NICs.
    a. Internally attached (internal bus standards)
    b. Externally attached (peripheral bus standards)
    c. On-board
    d. Wireless
    (TN Reading 2, 3, 4, 5; TN Writing 2, 4; TN Math N-Q)

17) Define a repeater and explain its limitations. Describe the characteristics of a hub; explain how it is a type of repeater, yet it still differs from the repeater. Install and configure the following types of hubs and identify their distinguishing characteristics.
    a. Passive
    b. Intelligent
    c. Managed
    d. Stand-alone
    e. Workgroup
    (TN Reading 2, 3, 4; TN Math N-Q)

18) Compare and contrast bridges with repeaters and hubs, identifying examples of advantages that bridges have over these devices. Provide supporting evidence to justify each example. (TN Reading 2, 4, 9)

19) Create and execute a plan to first install multiple nodes to a small switch, and then to connect the switch to another connectivity device. Verbally describe the steps of the procedure as they are being demonstrated. (TN Reading 2, 3, 4; TN Math N-Q)

20) Identify common gateway devices and explain how they are different from connectivity devices. Further, explain why the gateways must operate on multiple layers of the open systems interconnection (OSI) model. (TN Reading 2, 4)

Wireless Networking

21) Demonstrate understanding of wireless transmission technology. Use a combination of graphic illustrations and text to describe how a wireless signal originates from an electrical current and travels along a conductor. Include definitions and functions of the following concepts.
   a. Antenna
   b. Signal propagation
   c. Signal degradation
   d. Frequency ranges
   e. Narrowband, broadband, and spread spectrum signals
   f. Fixed vs. mobile
   (TN Reading 2, 4, 7, 9; TN Writing 2, 4)

22) Compare and contrast wireless local area network (WLAN) infrastructure to that of wired network topologies. Identify and explain the differences between the two layout types. (TN Reading 2, 4; TN Writing 2, 4)

23) Locate and access the 802.11 standards (wireless fidelity or Wi-Fi) developed by the Institute for Electrical and Electronics Engineers (IEEE). Explain the purpose of these standards, as well as how IT professionals should apply them to networking systems. (TN Reading 2, 4, 6)

24) Explore Bluetooth technology, differentiating between purposes of, and standards that govern, Bluetooth and other technologies (such as those governed by IEEE 802.111). (TN Reading 2, 4, 5, 6; TN Writing 2, 4)

25) Given specifications to install and configure a basic wireless network in a home or small office, write and execute a plan that includes, but is not limited to, the following:
   a. Install the client
   b. Locate and place the access point
   c. Install the access point
   d. Verify installation
   Provide details of the multistep procedure and justify the recommendations in the plan by providing supporting evidence that conforms to industry standards (e.g., Institute for Electrical and Electronics Engineers (IEEE) 802.11, Bluetooth). (TN Reading 2, 3, 4; TN Writing 1, 4; TN Math N-Q)

26) Given specifications to install and configure a wireless network in a large office, conduct a site survey to assess requirements of the clients, facility characteristics, and coverage area. Using the survey results, write and execute a plan that includes, but is not limited to, the following:
   a. Wireless access point placement
   b. Antenna types
   c. Interference
   d. Frequencies
   e. Channels
   f. Wireless standards
   g. Service set identifier (SSID) (e.g., enable/disable)

Provide details of the multistep procedure and justify the plan by providing supporting evidence that conforms to the Institute for Electrical and Electronics Engineers (IEEE) 802.11 standards. (TN Reading 2, 3, 4, 7; TN Writing 1, 4)

Network Operating Systems

27) In teams, research various types of network operating systems (NOS) (e.g., Microsoft Windows server, Linux enterprise server, UNIX, etc.). Identify the basic functions of a NOS, and synthesize the findings to write an explanatory text that includes, but is not limited to, the following:
    a. Guiding questions to determine the optimal software requirements
    b. Client support features
    c. Organization of network elements
    d. Sharing applications
    e. Managing system resources (e.g., memory, multitasking, multiprocessing)
    f. Why it is important to consider future needs
    Present the paper to other teams and revise it based on constructive feedback from peers. (TN Reading 2, 3, 4, 9; TN Writing 2, 4, 5, 6)

Security

28) Develop a plan for a regularly scheduled audit to examine a network's security risks. The plan should include, but is not limited to, the following:
    a. How often and when the audit will be conducted
    b. Security threats to be examined
    c. Rating system to assess the security threats
    d. Security policy goals and content
    e. How security breaches will be addressed
    Implement the security plan for the duration of the course, revising as necessary. (TN Reading 2, 3, 4; TN Writing 2, 4, 5)

29) Research and describe the most common security risks associated with people; data transmission and hardware; protocols and software; and internet access. Investigate and distinguish among the following common prevention methods to secure a network system.
    a. Physical security
    b. Security in network design
    c. Network operating system security
    d. Encryption
    e. Authentication protocols
    f. Wireless network security
    Given various scenarios, identify the most applicable best practices to secure a network. Implement these practices and write a justification for each scenario solution. Provide supporting evidence drawing on industry standards. (TN Reading 2, 3, 4, 6, 9; TN Writing 1, 4)

30) Explore the application of firewalls to secure networks. Describe their features and functions while distinguishing between the types (e.g., software and hardware). Install and configure a basic firewall. Verbally explain each step of the implementation process as it is executed. Cite any applicable industry standards. (TN Reading 1, 2, 3, 4)

31) Define fault tolerance, distinguishing between failures and faults in a network. Write a paper describing the following aspects that should be monitored and managed to sustain fault tolerance.
   a. Environment
   b. Power
   c. Topology and connectivity
   d. Servers
   e. Storage

   Identify those aspects that are most influential on fault tolerance and justify the claim with supporting evidence. Demonstrate the application of these practices and compare the changes (if any) in the tolerance to results generated by other classmates. (TN Reading 2, 4, 5; TN Writing 1, 2, 4)

Troubleshooting

32) For each network system problem given, apply the following general troubleshooting theory.
   a. Gather information from users or the system, back up data, and document findings
   b. Verify the problem exists and how many users are affected
   c. Isolate the cause of the problem and generate alternative solutions
   d. Determine whether escalation is necessary
   e. Plan a solution and resolve the problem
   f. Verify that the problem was resolved and prevent a future occurrence
   g. Document findings, resolution, and preventative maintenance plan

   Following the steps of the general troubleshooting theory, select a problem to present to classmates as a case study. (TN Reading 3, 4; TN Writing 2, 4)

33) For a given assignment related to the following common problems, follow the troubleshooting theory using appropriate hardware and software tools (e.g., cable tester, butt set, multimeter, protocol analyzer, throughput testers, connectivity software, etc.).
   a. Wireless problems (e.g., interference, signal strength, configurations, latency)
   b. Router and switch problems (e.g., switching loop, bad cables, port configuration)
   c. Physical connectivity problems (e.g., connectors, wiring, split cables, cable placement)

   Identify the problem(s) and document the findings and resolution. Include an explanation of the common symptoms, diagnostic procedures, and specific tools used that led to the problem resolution. (TN Reading 2, 3, 4, 8; TN Writing 2, 4, 7, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.

- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Cabling & Internetworking

Primary Career Cluster:	Information Technology
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6093
Prerequisite(s):	*Algebra I* (0842, 3102) and *Networking* (6097)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Networking Systems* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CompTIA Network+ CISCO Certified Networking Associates
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	523, 532, 533, 537, 582, 595, 701, 740
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

Cabling & Internetworking is an advanced course intended to equip students with the conceptual and practical skills necessary to install voice and data network cabling. This course emphasizes industry standards, types of media and cabling, physical and logical networks, and signal transmission. Upon completion of this course, proficient students will have skills in cable termination, reading network

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design documentation, pulling and mounting cable, setting up telecommunications rooms, basic cable testing and troubleshooting. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the fourth and final course in the *Networking Systems* program of study. For more information on the benefits and requirements of implementing this program in full, please see the program of study description documents found on the Information Technology website at http://www.tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Cabling Overview

1) Research the history and development of communications cabling to acquire knowledge of present-day network cabling concepts and uses, including but not limited to:
   a. The history of telephone and wireless communications in the United States
   b. The differences between analog and digital communication systems
   c. The three main types and typical applications of twisted-pair cabling
   d. Proper uses of plenum- and riser-rated cabling

   Create and deliver a brief presentation on at least one of the above topics, citing specific textual evidence. ~~(TN Reading 1, 2, 4, 7; TN Writing 4, 6, 9)~~

Safety

2) Assess a variety of situations requiring the use of network cabling and demonstrate the ability to follow procedures safely. Explain the applicability of various safety standards and procedures, including but not limited to:
   a. Safety codes and standards for the cabling materials and installation methods
   b. Safe practices working around electricity
   c. Workplace safety practices
   d. Personal safety equipment

   ~~(TN Reading 3, 4, 6; TN Writing 4)~~

Computers and Electronics

3) Compare and contrast aspects of communication signals carried by various types of cabling, identifying which types are best suited for different applications. Complete a graphic organizer to differentiate characteristics of:
   a. Analog signals versus digital signals
   b. Voltage signals versus optical signals
   c. Multiplexed signals

   Craft an argument on which type of signal is best suited for a specific application, developing both claim(s) and counterclaim(s) with fair evidence and reasoning. ~~(TN Reading 4, 7, 9; TN Writing 1, 4)~~

Transmission Media

4) Compare and contrast the typical applications for various types of data cables (such as twisted pair, coaxial cable, fiber optic), and the conditions under which a technician may use them. Defend the choice of cable for an example application, coherently and respectfully expressing the rationale behind the choice to a mock customer. (TN Reading 4; TN Writing 1, 4)

5) Compare and contrast conducting data cables with fiber-optic data cables, including but not limited to:
   a. Transmission modes (electrical conduction versus optical transmission)
   b. Connectors
   c. Installation issues
   d. Advantages and disadvantages
   (TN Reading 1)

Specifications and Standards

6) Research wiring standards and the organizations responsible for drafting and overseeing them. During a practice installation, explain how the communication of the standards impacts a user's ability to specify, install, and test the appropriate cabling. The subject organizations should include:
   a. American National Standards Institute (ANSI)
   b. Telecommunications Industry Association (TIA)
   c. Electronics Industries Alliance (EIA)
   (TN Reading 1, 3, 6)

7) During a practice installation of data cabling, describe the applicability of the National Electrical Code (NEC) and Underwriters Laboratories (UL) requirements, citing specific textual evidence. (TN Reading 1, 3, 6; TN Writing 4)

Cabling System Design

8) Design a telecommunications closet (TC) for a Local Area Network (LAN) installation. Craft a full explanatory text that cites specific textual evidence in descriptions of:
   a. Differences between TC and equipment rooms
   b. Recommended number of TCs in a large building
   c. TC construction standards (including required and prohibited features and dimensions)
   d. Typical equipment and features in TC
   e. Required environmental conditions inside the TC
   (TN Reading 1, 7; TN Writing 2, 4; TN Math N-Q, A-SSE, A-CED)

9) Explain and demonstrate, in writing or a presentation, the role played by each component in a typical star network installation, including the Network Interface card (NIC), media converter, repeater, hub, bridge, switch, server, and router. For each component, detail the likely consequences in the event of failure, and prescribe strategies for prevention and maintenance. (TN Reading 3, 4, 7; TN Writing 2, 4, 6; TN Math N-Q, A-SSE)

Cabling Installations

10) Plan and implement a small-scale LAN installation, properly using the tools, techniques, and materials accepted in cabling industry, including but not limited to building schematics, wire cutters and wire strippers, cable crimpers, punch-down tool, "fish tape" and pull/pushrods, diagnostic test tools, lubricants, and cable identification tags. Before completing installation, design a summary document that includes a narrative of activities and a graphic illustration of sites to share with potential customer. (TN Reading 3, 7; TN Writing 2, 4, 7; TN Math N-Q, A-SSE, G-GMD, G-MG)

11) As part of a real or practice installation, explain and demonstrate the rough-in phase for both horizontal and vertical installations of data cabling in a small office, including but not limited to horizontal and vertical installations, fire stops, and telecommunications closet construction or upgrades. (TN Reading 3, 4, 5, 7, 8; TN Writing 2, 4, 6; TN Math N-Q, A-SSE, G-SRT, G-GMD, G-MG)

12) As part of a real or practice installation, explain and demonstrate the trim-out phase of an installation, including but not limited to cable management, connectors and splices for copper media and fiber-optic media, and patch panels. (TN Reading 3, 4, 5, 7, 8; TN Writing 2, 4, 5, 6; TN Math N-Q, A-SSE)

13) As part of a real or practice installation, explain and demonstrate the completion stage of an installation, including but not limited to cable testing and certification, performance testing, final dressing of the installation, and documentation and drawings representing the finished installation and test results. (TN Reading 3; TN Writing 4; TN Math N-Q, A-SSE)

Special Cabling Situations

14) Demonstrate an understanding of the special cabling situations required for high bandwidth scenarios, providing power over Ethernet (PoE), standards of SCADA systems, industrial-grade data cabling requirements, and preventive maintenance programs for cable systems. Create and deliver a brief presentation on at least one of the above topics, citing specific textual evidence. (TN Reading 1, 3, 4; TN Writing 4, 6, 8)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

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- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

IT Clinical Internship

Primary Career Cluster:	Information Technology
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6096
Prerequisite(s):	Two credits in the *Networking Systems* program of study
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses.
Programs of Study and Sequence:	This is the final course in the *Networking Systems* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CompTIA A+ and CompTIA Network+
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Required Teacher Certifications/Training:	NetPlus or CISCO Industry Certification Teachers must be trained in Work-Based Learning
Teacher Endorsement(s):	153, 311, 435, 436, 475, 476, 582, 595, 740
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Course Description

IT Clinical Internship is a capstone course and work-based learning experience designed to provide students with real-world application of skills and knowledge obtained in previous *Networking Systems* courses. Students are eligible to take the *IT Clinical Internship* if they have successfully completed all the

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prerequisites in the *Networking Systems* program of study. Prospective students must apply for admission to the class (acceptance at the discretion of the instructor). The internships are designed to be completed in an IT Support environment, such as the student's school, a community-based shop that provides IT Support, or the IT Support department of a local business. This course puts to practical use all of the skills attained in previous courses, and provides the student with valuable hands-on experience. It meets the recommended 500 hours' work experience to prepare each student to sit for the CompTIA A+ exams, which certifies industry-recognized IT Support technicians. Upon completion of this course, proficient students will be prepared to pursue further training at a Tennessee College of Applied Technology (TCAT) or other postsecondary institution. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects.*~~

Work-Based Learning Framework

Clinical experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. The TDOE provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities. Additionally, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning.

Program of Study Application

This is the capstone course in the *Networking Systems* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

1) Accurately read, interpret and demonstrate adherence to safety guidelines appropriate for the roles and responsibilities of an employee in an IT setting. Listen to safety instructions and be able to explain why certain rules apply. Demonstrate safety techniques and follow all applicable guidelines related to the clinical placement. Based on placement, document completion of training topics on the appropriate work-based learning (WBL) and work site forms. ~~(TN Reading 2, 3, 4; TN Writing 4, 9)~~

2) Develop a personalized student-learning plan, in accordance with approved policies, to address the methods for practicing and demonstrating each of the skills identified in the pre-requisite IT course standards. Relate how each skill applies to a placement in an IT setting, and document day-to-day applications. Participate in ongoing review and communications around progress of plan with WBL Coordinator. ~~(TN Reading 1, 2, 3, 4, 9; TN Writing 2, 4, 5, 6, 7, 8, 9)~~

3) Observe and analyze organizational culture and practices, e.g., how to interact with supervisors, clients, and co-workers, and how to recognize and address health, safety, and sustainability issues. Seek information from supervisors and other employees about appropriate methods of pursuing employment in the industry, and determine what knowledge, skills, and educational credentials are required. ~~(TN Reading 2, 9)~~

4) Apply learning experiences from internship placement to review and update an education and career pathways plan based on the knowledge and feedback acquired. Proactively identify areas of strength and opportunities for professional growth, encourage and act on feedback from peers, supervisors, and customers, and seek and use resources and support to improve skills. (TN Reading 4; TN Writing 8, 9)

5) Identify and ask significant questions to solve problems in the workplace. Use inductive and deductive reasoning methods to recognize faulty reasoning, and to understand problems and alternative solutions. (TN Reading 2, 8; TN Writing 7, 8, 9)

6) Analyze quality assurance methods used by IT professionals in a variety of industries. Solve problems using systems thinking, e.g., by understanding problems in terms of complex processes and environments. Identify key components and relationships that enable, influence, and produce outcomes. (TN Reading 3, 7, 8; TN Writing 7, 8, 9)

7) Demonstrate integrity and ethical behavior when engaging in all worksite activities, including the secure use of client data, responsible Internet use, use of tools and materials, documentation of services provided, sharing of information, client relations, and completion of all personnel-related forms. (TN Reading 4; TN Writing 8)

8) Articulate ideas effectively in written personal communications with supervisors, coworkers, and customers using appropriate IT terminology, reviewing and revising as needed and developing claims with appropriate evidence and reasoning. Verbally articulate ideas effectively in interpersonal communications with supervisors, coworkers, and customers. Develop and deliver messages effectively in oral presentations. Demonstrate effective listening skills, attending to the meaning and intention of communication, and accurately paraphrasing what has been heard. Communicate effectively with individuals of diverse backgrounds who may also speak languages other than English, using foreign language skills as appropriate. (TN Reading 3, 4, 9; TN Writing 1, 4, 5)

9) Work effectively as a member of a team and address conflict with sensitivity and respect for diverse points of view. Demonstrate understanding of one's own impact and build on different perspectives to strengthen joint efforts. Demonstrate leadership where appropriate to collaborate on workplace tasks. Effectively employ meeting management strategies, such as agenda setting, time keeping, and meeting facilitation strategies, and list action items to identify and schedule next steps. (TN Reading 9)

10) Access information efficiently, using sources appropriate to task, purpose, and audience. Distinguish between credible and non-credible sources, including the difference between advertising and legitimate research. Evaluate information for usefulness, bias, and accuracy, and question information that may not originate from credible sources. Demonstrate the ability to organize and manage information effectively and efficiently. Demonstrate ethical and legal use of information, including adherence to all rules and regulations related to sharing of protected information. For example, when a user reports a network system problem, investigate and verify that the problem exists, determine how many users are affected, and diagnose the problem using the information at hand. (TN Reading 2, 3, 4, 5, 6, 9; TN Writing 4, 8, 9)

11) Use appropriate technology for information search and retrieval, synchronous and asynchronous communications, multimedia presentations, document production, quantitative and qualitative analysis, and information management. Use social networking and online collaboration tools such as shared documents and web conferencing to create, integrate, and manage information in group projects. (TN Reading 2, 9; TN Writing 6, 9)

12) Access and manage online communication and information, such as a customer relationship management system, using multiple digital devices. Demonstrate adherence to all rules and regulations related to the use of electronic tools and the Internet, including appropriate protection of passcodes and adherence to all security protocols. (TN Reading 3, 7, 8, 9; TN Writing 6, 9)

13) Complete tasks as directed without direct supervision, knowing when questions or guidance should be requested. Exhibit resourcefulness and initiative in taking on new tasks and solving problems on one's own as appropriate to the workplace setting. Demonstrate how to learn and exhibit personal agency in identifying and achieving instrumental and ultimate learning objectives. Demonstrate curiosity to learn more about the tasks, workplace, and/or industry. Explore deeper content on one's own and request opportunities for professional development. Demonstrate self-efficacy and confidence in one's ability to succeed in specific situations. (TN Reading 3, 4; TN Writing 8, 9)

14) Present oneself professionally and respectfully when interacting with coworkers, supervisors, and customers. Demonstrate reliability and responsibility in attendance and in following through on agreed upon tasks, and communicate with supervisor when circumstances change. Understand and adhere to appropriate workplace non-discrimination standards on the basis of sex, race, color, age, national origin, religion, disability, marital status, sexual orientation, gender identity, pregnancy, veteran status, or any characteristic of a person or group unrelated to the workplace. Respect cultural differences and work effectively with people from diverse social and cultural backgrounds. (TN Reading 9; TN Writing 7)

15) Exhibit flexibility by adapting to varied roles, jobs responsibilities, schedules and contexts; working effectively in a climate of ambiguity and changing priorities; and dealing positively with praise, setbacks, and constructive criticism. (TN Reading 9)

16) Manage time and projects effectively by setting goals; developing and using a system for prioritizing, planning and managing daily work; persisting in the face of challenges; and seeking assistance and adjusting plans to adapt to changing circumstances. Demonstrate attention to detail and accuracy appropriate to the task. Demonstrate accountability to supervisors, coworkers, and customers by delivering work to agreed-upon standards; accepting constructive criticism; completing agreed-upon projects on time; and exhibiting pride in workmanship. (TN Reading 4, 9; TN Writing 4, 8, 9)

17) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous Networking Systems courses and applied in the internship experience. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the troubleshooting process, as outlined by the instructor. The following documents will reside in the career portfolio:
    a. Career and professional development plan

b. Resume
c. Documentation of work hours at each site
d. List of responsibilities undertaken throughout the placement
e. Examples of materials developed and used throughout the placement
f. Periodic journal entries reflecting on tasks and activities
g. Supervisor evaluations and observations
h. Approved WBL forms
i. WBL coordinator evaluations and observations
(TN Reading 1, 3, 4, 9; TN Writing 4, 5, 6, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Web Design Foundations

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6100
Pre-requisite(s):	*Information Technology Foundations* (6095)*, Algebra I* (0842, 3102)*, Geometry* (0843, 3108)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the second course in the *Web Design* program of study.
Aligned Student Organization(s):	Future Business Leaders of America (FBLA) www.fblatn.org Sarah Williams, (615) 532-2829, Sarah.G.Williams@tn.gov Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CIW Internet Business Associate
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	037, 041, 055, 056, 057, 070, 203, 204, 230, 231, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079),(043 and 044),(043 and 045),(043 and 046),(043 and 047),(043 and 077), (043 and 078), (043 and 079), (044 and045), (044 and 046), (044 and 047), (044 and 077), (044 and 078), (044and 079), (045 and 046), (045 and 047), (045 and 077), 232, 233, (045 and078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046and 079), (046 and 047), (047 and 079), (047 and 077), (047 and 078),(077 and 078),(077 and 079),(078 and 079), 311, 435, 436, 470, 477, 475, 476, 516, 519, 582, 583, 595, 153, 157, 203, 204, 232, 233, 434, 543, 711,740
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Approved January 30, 2015; Amended April 15, 2016

Course Description

Web Design Foundations is a course that prepares students with work-related web design skills for advancement into postsecondary education and industry. The course is intended to develop fundamental skills in both theory and practical application of the basic web design and development process, project management and teamwork, troubleshooting and problem solving, and interpersonal skill development. Laboratory facilities and experiences simulate those found in the web design and development industry; where interaction with a "client" is indicated in the standards, it is expected that students' peers or the instructor may serve as mock clients in lieu of an actual relationship with an industry partner. Upon completion of this course, proficient students will be prepared for more advanced coursework in the Web Design program of study. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Web Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Internet safety, (4) Occupational Safety and Health Administration (OSHA) guidelines, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

Client Relations

2) Create a questionnaire and conduct an interview with a client to gather specific information to guide the web development project. Develop interview questions that will determine the purpose; target audience; branding and perception goals; content sources; and any factors that will affect the project schedule. ~~(TN Reading 1; TN Writing 4)~~

3) Using the information gathered from the client interview, write a project brief that identifies the goals, audience profile, audience perception, primary message of the web site, and the competitive advantage of the client. Allow the client to review the project brief and make corrections based on client feedback. ~~(TN Reading 1; TN Writing 2, 4, 5)~~

4) Research the specifications that will be required to produce a web site that meets the needs of the project brief. Using the findings, produce technical specifications for the web site. For example, the specifications should consider the screen resolution, browser compatibility, download time for the web site, and accessibility. ~~(TN Reading 2, 3; TN Writing 4)~~

5) Demonstrate an understanding of maintenance requirements for a web site that is aligned with the project brief. Develop a plan that thoroughly describes how the site will be consistently

updated and reviewed. Write a text explaining the maintenance requirements and plan to a client. For example, a web site maintenance plan should include, but is not limited to, any automated processes for changing content, required training for content contributors, and assignments for specific updates (e.g., keyword, search engine, Meta data, and graphics). (TN Reading 2; TN Writing 2, 4)

Site Mapping

6) Conduct a brainstorming session to solicit a client's feedback on web site content. Create an outline that organizes the content into categories. Ensure that the outline is aligned with the project brief and that there is space for future expansion. Present the outline to the client for review and approval. For example, use a mind mapping process to capture all the ideas and topics for a web site development project. (TN Reading 1, 2; TN Writing 2, 4, 5)

7) Applying the content outline, develop a diagram that visually represents the web site structure. The site map (or web site wireframe) should show the interconnection of features such as the homepage, links, and content for each link. For example, use software like Google Drawings, Microsoft Visio, OmniGiraffe, Adobe Illustrator, or Microsoft Office to create a web site wireframe. (TN Reading 2, 4, 7; TN Writing 4)

8) Convert the web site wireframes to individual web page wireframes. A wireframe should consider each element (e.g., navigation, images, content, functionality, and footer) and group the information of its corresponding page. (TN Reading 2, 4, 7; TN Writing 4)

Copyright/Licensing

9) Explore the use of stock images and demonstrate an understanding of the various types of stock images like stock photography, microstock photography, and free (e.g., open source) images. Identify the advantages and disadvantages of using these images. (TN Reading 1, 9)

10) Compare and contrast royalty-free and rights-managed licensing and explain how each licensing affects the use of images. Research and describe the process to obtain permission to use copyrighted photography. (TN Reading 2, 9)

11) Investigate multiple photosharing services and how they embed metadata within images to assist in keyword searches. As a class, create a photosharing system (class use only) for student-created images that include embedded metadata. (TN Reading 1, 2)

Introduction to Design and Layout

12) Demonstrate an understanding for how specific characteristics affect the quality and size of a digital image. Define the following terminology and explain their effects on digital images:
    a. Pixels
    b. Color depth
    c. Resolution
    d. Palettes
    e. Dithering
    (TN Reading 1, 4)

13) Compare and contrast raster and vector graphics and provide scenarios when it is best to use each format. Further, explore their applications to vector-based drawing and paint programs. Describe advantages and disadvantages of using each program type. (TN Reading 2, 5, 9)

14) Research and identify the extensions of various image file formats like Bitmap, Tagged Image File Format, Windows Metafile, Joint Photographic Experts Group, Portable Network Graphics, and Graphics Interchange Format. Describe which file formats are supported by all browsers and which formats require special software or a plug-in to view an image. Explain when it is most appropriate to apply specific image file formats. (TN Reading 4, 9; TN Writing 1)

15) In teams, investigate image optimization and its importance. Describe how file formats influence image optimization and identify optimization guidelines and sources to apply to web graphics. (TN Reading 1, 4)

16) Explain the graphic design concept of composition. Include various applications like visual hierarchy, grouping, visual cues, and integration of elements. (TN Reading 1, 4)

17) Explore the use of grid-based layout and why it is used to create coherent, organized web pages. Give examples of when it is suitable to use one-, two-, and three-column layouts to display content. For example, research and discuss how the golden ratio (golden mean) is used to create a design grid. (TN Reading 4, 9)

18) Drawing on multiple resources, demonstrate an understanding of typography, including related definitions like measure and lead. Explain a designer's application of the following typography characteristics to create balance and relationship between elements on a web page.
   a. Legibility
   b. Typeface
   c. Case
   d. Emphasis
   e. Type size and accessibility
   (TN Reading 2, 4, 5)

Composition

19) Conduct research to determine how various colors are perceived by specific audiences and cultures. Citing evidence from research findings, explain the following concepts:
   a. Symbols, objects and images that attract or repel audiences
   b. Color combinations that complement each other
   c. Smooth color transitions and the effects on download time
   For example, create a class demonstration showing which colors are most complementary and how many colors define a color scheme. (TN Reading 4, 9)

20) Demonstrate an understanding of the relationship between pixels and display color. Explain how black and white are each created using color schemes CMYK (cyan, magenta, yellow, and black) and RGB (red, green, blue) respectively. Furthermore, describe the differences between subtractive and additive colors and how they are applied to print media versus a computer monitor display. (TN Reading 4, 9)

21) Consider the two standardized numeric formats for color on the computer screen—RGB values and Hexadecimal code. Compare and contrast the format of values for each and briefly explain how they are applied to represent color. (TN Reading 4, 9; TN Math N-Q, A-CED)

Writing, Critiquing, and Publishing Content for the Web

22) In teams, research writing styles on various web sites (include sites of well-known organizations and companies). Identify characteristics that are consistently used and include examples of what made the text memorable and easy to scan. Use the research findings to create guidelines for the class to apply to upcoming web design and development projects. During the survey of writing styles on the web, take notice of the following:
   a. Location of important information on the page
   b. Use of bulleted lists and tables
   c. Length and simplicity of paragraphs
   d. Headlines and introduction sentences
   e. Tone and voice used
   f. Accuracy of information (current or outdated)
   (TN Reading 2, 9; TN Writing 4, 7, 8)

23) Given a specific topic from a web development project, write content for a web page and apply the class writing guidelines. Proofread and rewrite the content to align with the class guidelines. Give the writing assignment to multiple classmates for review. Revise the content based on reviewer feedback. Follow this multistep process until the written product is appropriate for publication on a web site. (TN Reading 1, TN Writing 4, 5, 6)

Marketing, Branding, Identity, and eCommerce

24) Research various logos of well-known companies and organizations on the web. Identify shapes and colors that are consistently used and include examples of what made the logos unique, attractive, and memorable. (TN Reading 1, 4, 9)

25) Drawing from various resources, identify several ways that a web designer can apply and strengthen brand management and identity. Consider the concepts consistent color and logo placement and explain the application of each. (TN Reading 1, 4, 8, 9)

26) Investigate how to setup and implement a secure e-commerce site. Citing evidence from reliable resources, describe 1) measures to prevent shopping cart vulnerabilities, 2) pre-built shopping software, and 3) hosting options for shopping cart software. (TN Reading 1, 2, 3)

27) In teams, examine how demographics, psychographics, and audience data are used to market a product or service online. Using this information, create a questionnaire to survey people about a product or service. For example, the questionnaire could survey alternative promotion methods, market growth drivers and barriers. (TN Reading 2, TN Writing 4, 5, 8, 9)

28) As a team, use the survey results and develop a marketing plan that identifies the following for a web development project.
   a. Promotions for both global (mass) and niche (micro) markets
   b. Web marketing strategies and goals

    c.   Market growth drivers and barriers
    d.   Product distribution and availability
    e.   Product or service pricing
    f.   Advertising options to be used (e.g., links, banner ads, viral marketing, social media)
(TN Reading 1, 3; TN Writing 4, 5)

Introducing Coding Skills

29) Research the history of markup languages; briefly describe the function of markup languages and why they are different from programming languages. (TN Reading 1, 9)

30) Explore the origin of the HTML standard and creation of the World Wide Web Consortium (W3C). Discuss the six versions of the HTML standard and how each differs from the other. Explain the role of standardization and provide examples of how it promotes universality for all web users. (TN Reading 1, 4, 9)

31) Define HTML tags distinguishing between empty tags and container tags. Explain their application to web development, why Hypertext Markup Language (HTML) evolved, and provide examples of tags frequently used. Create a simple web page that consists of paragraph text, text hyperlinks, tables, and elements in frames. (TN Reading 1, 4)

32) Demonstrate understanding of Cascading Style Sheets (CSS). Investigate and report how CSS separate formatting elements from HTML and solve a number of design limitations like:
    a.   Proprietary HTML extensions
    b.   Text-to-image conversion to retain fonts
    c.   Page layout using tables
    d.   Images controlling white space
(TN Reading 1, 4, 6)

33) Explore the use of Cascading Style Sheets (CSS) for page layout and cite evidence why CSS provides more flexible and precise layout capabilities than tables and frames. Explain and demonstrate coding for the following elements of CSS page layout.
    a.   CSS Box Model (e.g., inline, block)
    b.   Document Flow and Positioning (e.g., static, relative, absolute, fixed, float, z-index)
    c.   CSS Positioning Schemes (e.g., two-column layout, three-column layout)
(TN Reading 1, 3, 4, 8; TN Writing 6)

Organization

34) As a class, define the guidelines for effective use of file and folder management techniques to maintain directory structure for forthcoming web site class projects. The guidelines should address efficient methods for maintaining site root and subfolders for assets (e.g., images, templates, CSS), as well as the correct way to use file paths for relative, site root relative, and absolute links. (TN Reading 1, 2, 4; TN Writing 7)

Troubleshooting & Problem Solving

35) Troubleshooting and formal testing is a systematic quality assurance process and should be routinely completed throughout the life cycle of a web site. There are various multistep testing procedures for a web site. The following recommendations provide a general approach to testing:

    a. Review the content for accuracy, spelling, and grammar
    b. Review site for broken links
    c. Test the functionality of the web site as defined by the project specifications
    d. Validate the HTML and CSS coding
    e. Check the accessibility using automated tools
    f. Test site on various browsers that the target audience uses
    g. Analyze the connection speed and size of web pages
    h. Conduct usability testing with target audience
    i. Work with the server administrator to conduct load testing
    j. Conduct authentication testing and review file authorizations

As a class, develop a quality assurance plan that incorporates the above testing procedures, as well as outlines how the testing will be managed, how the issues will be prioritized, and how problems will be solved. (TN Reading 7; TN Writing 1, 4)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and algebraic reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Web Site Development

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6101
Prerequisite(s):	*Web Design Foundations* (6100)
Credit:	1
Grade Level:	11-12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the third course in the *Web Design* program of study.
Aligned Student Organization(s):	Future Business Leaders of America (FBLA) www.fblatn.org Sarah Williams, (615) 532-2829, Sarah.G.Williams@tn.gov Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CIW Internet Business Associate Certification
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 203, 204, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047),(043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079),(046 and 047), (046 and 077), (046 and 078), (046 and 079), (046 and047), (046 and 077), (047 and 079), (047 and 077), (047 and 078), (077and 078), (077 and 079), (078 and 079), 153, 157, 311, 435, 436, 470, 475, 476, 477, 516, 519, 582, 583, 595, 543, 711, 740, 037, 041, 055, 056, 057,434
Required Teacher Certifications/Training:	CIW Association Foundation Certification or CIW Site Designer Industry Certification. For endorsements 037, 041, 055, 056, 057, 203, 204, 311, 434, 435, 436, 475, 476, 153 CIW Web Design Specialist Industry Certification required in 2015-16.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Approved January 30, 2015; Amended April 15, 2016

Course Description

Web Site Development builds on the skills and knowledge gained in *Web Design Foundations* to further prepare students for success in the web design and development fields. Emphasis is placed on applying the design process toward projects of increasing sophistication, culminating in the production of a functional, static website. As students work toward this goal, they acquire key skills in coding, project management, basic troubleshooting and validation, and content development and analysis. Artifacts of the work completed in this course will be logged in a student portfolio demonstrating mastery of skills and knowledge. Upon completion of this course, proficient students will be prepared to pursue a variety of postsecondary programs in the computer sciences, sit for industry certification, or apply their skills in a capstone *Web Design Practicum*. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the third course in the *Web Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety rules, including rules published by the (1) National Science Teachers Association (NSTA), (2) rules pertaining to electrical safety, (3) Internet safety, (4) Occupational Safety and Health Administration (OSHA) guidelines, and (5) state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Throughout the course, practice safe habits and procedures when sharing and sending files, navigating websites, and connecting to servers and networks. As a class, work collaboratively to develop a professionalism policy that outlines rules regarding responsible technology use in the classroom. The policy must adhere to all school and district technology policies. ~~(TN Reading 3, TN Writing 4)~~

3) Determine how companies, organizations, and individuals keep their data secure from theft and identity fraud. Summarize and produce a list of best practices from industry magazines and professional organizations such as the World Wide Web Consortium (W3C). Identify steps for safe use and transfer of data that can applied in the Web Design classroom. ~~(TN Reading 1, 2; TN Writing 4, 7)~~

Career Exploration

4) Investigate opportunities for personal and professional growth in the web design and computer science fields, including but not limited to opportunities to enter design contests, assist with the maintenance or development of the school's website, and participate in initiatives such as the

national Hour of Code. In addition, explore postsecondary programs in the computer sciences, such as web design and development, animation and graphics, or website administration, and document the search in the course portfolio. (TN Reading 1, 2)

The Design Process

5) Select a website whose content is appropriate and adheres to the course policy, as approved by the instructor. Critically evaluate the site on the merits of its design features, applying knowledge and skills related to webpage composition (learned in *Web Design Foundations*) to critique the following:
   a. Navigational hierarchy
   b. Balance
   c. Color unity
   d. Typography, formatting, and other aspects of text layout and style
   e. Compatibility across multiple browsers and devices
   f. Flow and arrangement of content

   Develop a presentation, written paper, or blog post analyzing these elements, supported by screen shots of the website and other specific evidence drawn from the site. Be able to answer the question, "What makes this website compelling, attractive, and functional?" (TN Reading 1, 2, 5, 6, 8; TN Writing 1, 7, 9)

6) Synthesize the steps of the web design process learned in previous courses with research into emerging or alternative design models. In groups, produce a sophisticated flowchart, diagram, or other logic model that will serve as a template to guide the development of all projects and activities undertaken in this course. Annotate the model with the inputs, constraints, activities, and target outcomes involved in a given project; demonstrate where inputs flow from one stage of a project to the next. (TN Reading 7, 8, 9; TN Writing 4)

Project Management

7) Research how web development teams use project management tools to divide roles and responsibilities among team members, track progress toward goals, and satisfy client specifications. Explore a variety of such tools and develop systems for applying selected tools to projects and assignments in this course. For example, download a Gantt chart template for a spreadsheet software application and use it to assign tasks and monitor deliverables working toward a given deadline. (TN Reading 1, 2, 9; TN Writing 4, 6, 7)

Coding Skills

8) Demonstrate technical fluency in a variety of programming and markup languages, including but not limited to HTML, XML, CSS, JavaScript, JQuery, PHP, and/or SQL. Describe the particular functions and environments in which each language operates, detailing the benefits, limitations, and unique features of each. Justify when one programming language would be ideal for a given project or design solution, developing the recommendation with specific evidence and reasoning. (TN Reading 2, 3, 4; TN Writing 1, 6)

9) Correctly apply tags, embed links, manipulate space, customize attributes, and incorporate style elements related to typography, margins, and spanning and padding. Demonstrate the ability to

code web page elements such as tables and forms according to the specifications of the client. (TN Reading 3; TN Writing 6)

10) Distinguish between different units and measurement systems used in website development. Be able to accurately define terms such as size, aspect ratio, percentage units, and pixels as they relate to specific style commands (i.e., in a cascading style sheet). Given a set of design constraints or client specifications, accurately apply and modify the appropriate units when writing and editing code for objects/text in a programming environment. (TN Reading 3, 7; TN Writing 6; TN Math N-Q)

11) Throughout the course, apply, edit, and continually revise code using software approved by the instructor, ranging from proprietary software such as Dreamweaver to simple applications like Microsoft Notepad. Practice teamwork and revision skills by: 1) critiquing the work of peers; and 2) furnishing recommendations for resolving errors in syntax and improving elements of design. Annotate recommendations in the programming environment to facilitate peer review. (TN Reading 3, 4, 5, 6; TN Writing 1, 4, 5, 6)

12) Create and edit graphics and other multimedia for web pages, evaluating and customizing their attributes according to client/instructor specifications. For example, write code for a scalable vector graphic (SVG) with a predetermined height, width, shape, and color, using appropriate units in order to maximize visibility and continuity of design. (TN Reading 3; TN Writing 6; TN Math N-Q)

13) Summarize the functions of plug-ins for content management systems as well as static websites. Describe a range of plug-ins and justify when they are needed for a specific application. Demonstrate the ability to download and install plug-ins for selected assignments in support of a specified design goal. (TN Reading 2, 3; TN Writing 6)

Basic Troubleshooting and Validation

14) Apply basic troubleshooting strategies to resolve errors in syntax, fix broken links, edit distorted images, and align website content for seamless navigation. As part of a course assignment or project, practice troubleshooting techniques to meet the vision or specifications of a mock client. For example, pretend a client complains that the alpha version of his/her website has rendered the dimensions of an interactive form too small for customers to read. Accurately diagnose the problem, then make adjustments to the code to resolve the issue to the client's satisfaction. (TN Reading 3, 5, 7, 8; TN Writing 6, 7)

15) Research methods of performing code validation on a completed or in-progress web page. Validate code for compatibility across browsers and devices. Explain the results of the validation test to the class in the form of a brief presentation as would a team of developers. (TN Reading 1, 9; TN Writing 2, 6, 7)

Content Development and Analysis

16) Conduct a preliminary investigation of various branding strategies (i.e., social media marketing, web advertising, etc.) used by companies that sell their products and services online. Evaluate selected companies' websites to determine how such strategies are deployed throughout the

sites. Describe how one or more of these strategies could be incorporated into a future website for this or another course. (TN Reading 1, 2, 5, 6, 7; TN Writing 4, 7, 8, 9)

17) Define web analytics, and discuss the increasingly sophisticated role that analytics play in the marketing and management of content for websites. Interpret simple analytics in the dashboard interface of a content management system such as WordPress. Use quantitative reasoning and appropriate terminology to describe trends, analyze performance, and explain to peers how a website's "reach" can be determined with analytics. (TN Reading 1, 3, 4, 7, 9; TN Writing 2, 9; TN Math N-Q)

18) Build on the work of previous Web Design courses and practice writing original web content for a particular audience. Adhere to client specifications regarding tone, length, and style of language, writing in a manner appropriate for the target audience. Regularly edit writing and solicit peer feedback for continuity of message and language. Collaboratively work to refine writing to be suitable for web publication. (TN Writing 4, 5, 6, 7)

Web Hosting and Publishing

19) Model the process for setting up a website. Investigate domain name availability, register with a hosting service, and download a File Transfer Protocol (FTP) program. As part of a course assignment or project, demonstrate the ability to upload and organize files onto a server and arrange content to map out a simple multi-page website. Maintain accurate and navigable directories for retrieving and storing files. Incorporate original writing content onto the site, and publish content online for the instructor or class to see on a standard Internet browser. (TN Reading 3, 4; TN Writing 4, 6)

Trends in Web Design and Development

20) Explore a range of new and emerging trends in web design and development. A trend could be a new software, strategy, programming language, or phenomenon that has seen rising or widespread usage on the Internet in recent years. Examples include the movement toward responsive design to expand website compatibility; the increasing use of HTML5; or the embedding of social media within websites for the purposes of sharing content or crowdsourcing a product idea. Research one or more of these trends in depth, and compile a presentation or a paper explaining both the technical aspects involved (i.e., how it works on a web page) and the practical applications it has for customers, webmasters, businesses, or other users. (TN Reading 1, 2, 9; TN Writing 2, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Web Design Practicum

Primary Career Cluster:	Information Technology (IT)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6171
Prerequisite(s):	*Web Site Development* (6101)
Credit:	1
Grade Level:	11-12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other IT courses.
Programs of Study and Sequence:	This is the fourth course in the *Web Design* program of study.
Aligned Student Organization(s):	Future Business Leaders of America (FBLA) www.fblatn.org Sarah Williams, (615) 532-2829, Sarah.G.Williams@tn.gov Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	CIW Internet Business Associate
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	070, 203, 204, 230, 231, 232, 233, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047),(043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079),(046 and 047), (046 and 077), (046 and 078), (046 and 079), (046 and047), (047 and 079), (047 and 077), (047 and 078), (077 and 078), (077and 079), (078 and 079), 153, 157, 311, 435, 436, 470, 475, 476, 477, 516,519, 582, 583, 595, 543, 711, 740, 037, 041, 055, 056, 057, 434
Required Teacher Certifications/Training:	CIW Association Foundation Certification or CIW Site Designer Industry Certification. For endorsements 037, 041, 055, 056, 057, 203, 204, 311, 434, 435, 436, 475, 476,153 CIW Web Design Specialist Industry Certification required in 2015-16.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-information-technology

Approved January 30, 2015; Amended April 15, 2016

Course Description

Web Design Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous *Web Design* courses toward the completion of an in-depth project with fellow team members. Students who have progressed to this level in the *Web Design* program of study take on more responsibilities for producing independent work and managing processes involved in the planning, designing, refinement, and launch of a website. In addition to developing an understanding of the professional and ethical issues encountered by web design professionals in the workplace, students learn to refine their skills in problem solving, troubleshooting, teamwork, marketing and analytics, and project management. Upon completion of the practicum, proficient students will be prepared for postsecondary study and career advancement in web design. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a *Personalized Learning Plan* template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Web Page Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Information Technology website at https://tn.gov/education/article/cte-cluster-information-technology.

Course Standards

Web Design Career Planning

1) Research a company or organization that provides web design/development services for clients. Companies could range from large design firms serving corporate clients, to independent freelance businesses operating in the local community. For the chosen company, cite specific textual evidence from the company's literature, as well as available press coverage (if available) to summarize:
    a. The mission and history of the organization
    b. Headquarters and organizational structure
    c. Products or services provided
    d. Credentials required for employment and how they are obtained and maintained
    e. Policies and procedures
    f. Reports, newsletters, and other documents published by the organization
    g. Website and contact information
    (TN Reading 1, 2; TN Writing 7)

2) Analyze the requirements and qualifications for various web design job postings identified from specific company websites or online metasearch engines. Gather information from multiple sources, such as sample resumes, interviews with web design professionals, and job boards, to determine effective strategies for realizing career goals. Create a personal resume modeled after elements based on the findings above, then complete an authentic job application as part of a career search or work-based learning experience. (TN Reading 4, 9; TN Writing 4, 7, 8)

3) Participate in a mock interview. Prior to the interview, research tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. (TN Reading 2; TN Writing 2, 4, 7, 9)

Professional Ethics and Legal Responsibilities

4) Investigate a range of unethical and illegal behaviors frequently encountered by web design professionals. Summarize the legal and professional consequences for engaging in these behaviors, developing claims and counterclaims about the potential ramifications for clients, users, the public, and one's own personal reputation. Deliver findings in the form of a summary document or presentation supported by evidence from news media, company policies, and state and federal laws. Potential issues include spam, flaming, cyberbullying, libel, slandering, and mining of personal data for profit. (TN Reading 1, 2, 4, 8, 9; TN Writing 1, 4, 6, 7)

5) Research a case study involving an ethical issue related to intellectual property rights. Examine a variety of perspectives surrounding the issue, then develop an original analysis explaining the impact of the issue on those involved, using persuasive language and citing evidence from the research. Potential issues include copyright infringement, piracy, plagiarism, art licensing, creative commons, and the state/federal laws that govern them. (TN Reading 1, 2; TN Writing 1, 4, 6, 7)

Course Project

6) Meet with a potential or mock client who requires a web-based digital product, and discuss the client's wants and needs for the product. In teams or individually, work to develop a project plan, set goals, delegate responsibilities, and determine deadlines to meet the client's specifications. Analyze available resources, then formulate and present a written proposal for the potential client detailing the following:
   a. Summary of product solution that can be offered
   b. Strategy for addressing the needs of the client
   c. Schedule of completion
   d. Cost to the client, including justification of expenses
   (TN Reading 7; TN Writing 1, 2, 6)

7) In teams or individually, develop a site map outlining the architecture of the web page(s) to be created in the project. Demonstrate the ability to group content in the form of a flowchart or other visual representation, and apply principles related to continuity of design. (TN Reading 3, 5, 7)

8) Work together to assemble adequate documentation of project activities, including end-user documentation. Be able to explain to both lay and technical audiences how various aspects of the site and/or digital product were developed and how they function. For example, annotate code where appropriate such that another web designer could replicate it; or explain to a first-time user how a form developed for the site retrieves and stores information in a remote database. (TN Reading 3, 4, 5, 6; TN Writing 2, 4, 6, 7)

9) Maintain accurate and accessible directories of files relevant to the project, and develop agreements among team members and client surrounding data management, naming conventions, version control, editing permissions, and sharing of files (for example, through cloud-based services or shared drives). (TN Reading 3)

10) Use appropriate authoring software to execute the project plan in line with budget constraints, server size, deadlines, and all other specifications in order to meet the vision of the client. In the course of development, apply coding skills to design, organize, create, maintain, and update the site or digital product as needed. (TN Reading 3, 7; TN Writing 4, 6, 7)

Advanced Troubleshooting, Critiquing, & Problem Solving

11) In the course of developing the web-based project, regularly test the site for functionality, navigability, browser and device compatibility, and other design aspects related to user friendliness. Conduct and document the proper code validation to fix broken links, distorted images, and similar errors. (TN Reading 3, 8; TN Writing 5, 6, 7)

12) Analyze the code written by another team member or peer and create a flowchart for suggesting changes to improve functionality. Cite specific examples in the code to support recommendations. (TN Reading 1, 2, 3, 4, 5, 6, 7, 8; TN Writing 1, 4, 6)

13) Apply coding skills learned in previous courses to novel contexts and development environments. For example, investigate methods for scaling the site or digital product onto a mobile device using responsive design. Where appropriate, incorporate the proper CSS code to render a site compatible on multiple web platforms. (TN Writing 6, 7)

Web Marketing and Analytics

14) Research factors that affect the sale and distribution of products and services over the Internet, such as the wide availability of customer feedback on sites like Amazon, Yelp, and Google. Select a company whose products/services are purchased online; describe how the factors identified above influence the design of the company's website. Critique the effectiveness of the site in promoting the company's product/service, citing evidence related to user friendliness, accessibility, tone, and composition. (TN Reading 5, 6, 8; TN Writing 1, 9)

15) Analyze a range of web marketing strategies and cite examples of how businesses use them to drive web traffic. Strategies include but are not limited to social media marketing, image-centric content marketing, search engine optimization (SEO), email marketing, or mobile-friendly content. Deliver a mock presentation to "peer clients" outlining how one or more of these strategies could be incorporated to increase the web presence of a real or fictitious business.

Drawing on success stories of similar companies, pitch the chosen strategy using persuasive language and relevant supporting data. (TN Reading 1, 4, 8, 9; TN Writing 1, 7, 8)

16) Describe how companies collect data using web analytics. Summarize a range of statistics used when tracking web traffic, such as unique page views, session duration, and bounce rate. Demonstrate the ability to collect and interpret analytics to achieve marketing goals; if applicable, incorporate such analysis into the course project. (TN Reading 1, 4, 8, 9; TN Writing 2, 9; TN Math S-ID)

17) Investigate the ways companies use web data to analyze demographic and psychographic information about their customers. Model to a "peer client" how an ordinary business owner can use IP geolocation, surveys, forms, and other tools to make strategic marketing decisions. (TN Reading 1, 4, 9; TN Writing 4)

Portfolio

18) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the design process. The following documents will reside in the student portfolio:
    a. Personal code of ethics
    b. Career and professional development plan
    c. Resume
    d. Links to web pages designed or contributed to
    e. List of responsibilities undertaken through the course
    f. Examples of visual materials developed and used during the course (such as graphics, drawings, models, presentation slides, videos, and demonstrations)
    g. Description of technology used, with examples if appropriate
    h. Periodic journal entries reflecting on tasks and activities
    i. Feedback from instructor and/or supervisor based on observations
    (TN Reading 7; TN Writing 4, 5, 6)

Communication of Project Results

19) Produce a technical report highlighting the purpose, content, use, and intended audience of the web-based project. Cite evidence from the code and from web development best practices in order to justify design decisions and maximize client satisfaction. Include appropriate documentation of license agreements, copyright protections, non-disclosure statements, and other legal issues if dealing with the ideas or data of others. (TN Reading 1, 2, 3, 4, 5, 7, 8, 9; TN Writing 1, 5, 6, 7, 8, 9)

20) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, flowcharts, sample code, and/or summary data generated from the site. Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Law, Corrections, and Security

Primary Career Cluster:	Law, Public Safety, Corrections, & Security
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	6155
Prerequisite(s):	*None*
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Law, Public Safety, Corrections, & Security courses.
Programs of Study and Sequence:	This is the first course in both the *Law Enforcement Services* and the *Legal and Correction Services* programs of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to your local postsecondary institution.
Teacher Endorsement(s):	590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-law-public-safety

Course Description

Principles of Law, Corrections, and Security is an introductory course designed to prepare students to pursue careers in the fields of law enforcement, legal services, corrections, and security. Upon completion of this course, a proficient student will be able to identify careers in these fields, summarize the laws that govern the application of justice, and draw key connections between the history of the

Approved April 10, 2015; Amended April 15, 2016

criminal justice system and the modern legal system. In addition, students will model the professional, moral, and ethical standards required of professionals in the fields of law, legal services, corrections, and security. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*~~

Program of Study Application

This is the first course in the *Law Enforcement Services* and *Legal and Correctional Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Law, Public Safety, Corrections, & Security website at https://tn.gov/education/article/cte-cluster-law-public-safety.

Course Standards

Foundations of the Criminal Justice System

1) Articulate important historical events and milestones (such as European influences) impacting the evolution of the current criminal justice system in the United States. Use a timeline or other graphic to illustrate the major developments from the colonial period to today, citing specific textual evidence from research. ~~(TN Reading 1, 2, 7; TN Writing 2, 9)~~

2) Summarize the six types of laws (Criminal, Civil, Case, Administrative, Statutory, Common), and discuss the purpose of each. Develop a graphic organizer to draw connections among sample laws for each type, relevant legal concepts such as burden of proof, and applicable defenses and punishments. ~~(TN Reading 2, 4, 5; TN Writing 4, 9)~~

3) Accurately describe the United States Constitution and Bill of Rights and justify its impact on criminal law and the rights of citizens, citing specific textual evidence from landmark legal cases. ~~(TN Reading 2, 5; TN Writing 4, 9)~~

4) Examine the differences and similarities between the concepts of crime, victimization, and criminal behavior. Define each term, in relation to the others, citing specific textual evidence from academic research or news media. ~~(TN Reading 1, 2, 4, 5; TN Writing 4, 9)~~

5) Citing evidence found in news media and legislation, describe the evolution of the modern criminal justice system to address terrorism, cybercrimes, and hate crimes. Include summaries of how society at large has been affected by both new and evolving threats and changing laws meant to deal with them. ~~(TN Reading 1; TN Writing 2, 4, 7, 9)~~

6) Conduct research to develop an argumentative essay that makes a claim about the influence of media on the legal system. Include reasoning that distinguishes between the reality of the legal system and the depiction of that system in movies and television. Develop claim(s) and counterclaim(s) fairly, supplying data and text-based evidence. ~~(TN Reading 1, 9; TN Writing 1, 7, 8, 9)~~

Career Planning and Compliance

7) Create a graphic organizer to illustrate the structure of the relationships among key players in the criminal justice system (including law enforcement organizations, legal service providers, corrections agencies, and security agencies) in the handling of crimes and of those who commit them. (TN Reading 4, 5; TN Writing 4)

8) Use local news media and organizational websites to investigate occupations that make up the four career areas (law enforcement, legal services, corrections, and security services) of the law and public safety sector. Demonstrate an understanding of each occupation by accurately articulating the following:
   a. Roles and responsibilities of the position
   b. Comparison of similar careers available in state, federal, and military criminal justice systems
   c. Educational, training, and certification requirements
   d. Location of occupations within the organizational hierarchy of the specific career area
   (TN Reading 1, 2; TN Writing 4, 7, 8, 9)

9) Prepare a career profile for at least one occupation in each of the four career areas, using print, online, and/or personal interview sources to capture at minimum the following:
   a. Job description
   b. Essential knowledge and skills needed for the career
   c. Program or path of study to reach occupational goals, beginning with high school and proceeding through postsecondary
   d. Licensure and credentialing requirements
   e. Non-educational job requirements such as physical fitness tests, minimum age, and psychological evaluations
   (TN Reading 2; TN Writing 4, 9)

Safety and Well-being

10) Summarize the dangers associated with careers in law, corrections, and security; support analysis with examples from actual cases reported in print and digital media. Provide examples of tactics an individual could employ to prevent or mitigate risks, including maintaining good health and physical fitness. (TN Reading 2; TN Writing 2, 9)

11) Identify stressors and stress-inducing situations for professionals in the Law, Public Safety, Corrections, and Security sector through interviews with professionals in the field. Collaborate with a team to identify techniques and strategies for managing and alleviating stress related to these professions. Communicate your recommendations in a toolkit, brochure, or factsheet to support the use of these strategies, citing specific textual evidence. (TN Reading 1, 2; TN Writing 4)

12) Successfully perform American Red Cross or American Heart Association Adult, Child, and Infant Basic Life Support and first aid skills. (TN Reading 3)

Ethics

13) Collect Codes of Ethics from professional organizations in law enforcement, legal services, corrections, and security services and examine areas of commonality. Synthesize principles from the codes investigated to create a personal code of ethics. (TN Reading 2; TN Writing 4, 7, 9)

14) Examine real-world situations that involve ethical dilemmas and the application of correct professional conduct as highlighted in recent news articles. Craft an argumentative essay making a claim about the importance of ethics and professional standards for persons working in the Law, Public Security, Corrections, and Security pathway, citing examples from case studies to argue for the relevance of professional codes of conduct. ~~(TN Reading 2; TN Writing 1, 4, 9)~~

Organization and Operations of Law, Public Safety, Corrections, and Security Agencies

15) Differentiate between the various agencies in the Law, Public Safety, Corrections, and Security sector at the local, state, and national levels by describing their jurisdiction, roles and responsibilities, and governing bodies. Identify conflicts in jurisdiction that may arise when multiple agencies work together, citing examples from case studies, interviews, or news articles. ~~(TN Reading 2, 9; TN Writing 4)~~

16) Differentiate the roles of private security and public law enforcement agencies and identify potential jurisdictional concerns. Using a specific example situation (such as a private company protecting against theft), develop a plan to utilize available security and law enforcement resources in a way that avoids conflicts over jurisdiction, follows applicable laws and regulations, and makes the best use of both private and taxpayer funded protection. ~~(TN Reading 5; TN Writing 4, 9)~~

17) Distinguish between the two major sources of crime statistics: the Federal Bureau of Investigation's (FBI) Uniform Crime Reporting Program (known as UCR/NIBRS) and the National Crime Victimization Survey (NCVS) of the Bureau of Justice Statistics (BJS). Explain how modern criminal justice agencies are utilizing statistics from both sources, comparing and contrasting the characteristics of the data sets in an informative artifact**. ~~(TN Reading 9; TN Writing 4)~~

Criminology

18) Define criminology and research the major behavioral science theories describing criminal behavior. Identify theorists and elaborate on their major contributions to the field; include emerging theories sourced from contemporary scholarship. Apply a specific theory to explain a notable crime. ~~(TN Reading 4, 5, 6, 8; TN Writing 4, 7, 9)~~

19) Generate a scenario in which a crime is committed and a suspect enters the criminal justice system. Describe in detail what happens at each of the following stages and what relevant actors participate in the process: investigation and arrest; pre-trial activities; adjudication; sentencing; corrections and re-entry. ~~(TN Writing 4, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

**Informative artifacts include, but are not limited to, graphic organizers, brochures, posters, fact sheets, narratives, essays, and presentations. Graphic illustrations include, but are not limited, to charts, tables, graphs, rubrics, drawings, and models.

Criminal Justice I

Primary Career Cluster:	Law, Public Safety, Corrections, & Security
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5987
Prerequisite(s):	*Principles of Law, Corrections and Security* (6155)
Credit:	1
Grade Level:	10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Law, Public Safety, Corrections, & Security courses.
Programs of Study and Sequence:	This is the second course in both the *Law Enforcement Services* and the *Legal and Correction Services* programs of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	A statewide dual credit challenge examination exists for this course for students to earn dual credit at Tennessee public postsecondary institutions that offer criminal justice. For more information, please visit http://www.tn.gov/education/section/early-postsecondary .
Teacher Endorsement(s):	590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-law-public-safety

Course Description

Criminal Justice I is the second course in *Law Enforcement Services* and the *Legal and Correctional Services* programs of study. It serves as a comprehensive survey of how the law enforcement, legal, and correctional systems interact with each other in the United States. Upon completion of this course, proficient students will understand the context of local, state, and federal laws, have investigative skills

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pertaining to basic crime scenes and incident documentation, and understand the importance of communications and professionalism in law enforcement. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*

Program of Study Application

This is the second course in the *Law Enforcement Services* and *Legal and Correction Services* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Law, Public Safety, Corrections, & Security website at https://tn.gov/education/article/cte-cluster-law-public-safety.

Course Standards

Communications in Law Enforcement

1) Define communication and explain the differences in verbal and non-verbal communication. Relate the ideas and concepts surrounding communication in the following situations: with a suspect, talking to another police officer, and when communicating with the public. Role-play verbal and non-verbal communication with classmates and family members using law enforcement terminology. (TN Reading 2, 3, 4)

2) Describe the specific skills required of law enforcement officials in order to effectively communicate with all individuals, including those with limited English proficiency, demonstrating sensitivity to cultural differences and other potential barriers to communication. Research the Americans with Disabilities Act (ADA) guidelines for law enforcement and demonstrate effective communication practices with persons of different ages and characteristics. (TN Reading 1, 2, 3)

3) Research and explain the protocols for handling a call received by a 911 dispatcher or police call center. Outline the procedure in an informational brochure or public service announcement for community members. Discuss basic law enforcement communication and telecommunication information (such as mobile and hand-held radios, car radios, and mobile data terminals), types of public alerting systems, and methods by which personnel are notified of an emergency. (TN Reading 2, 3, 4; TN Writing 4, 9)

4) Compare and contrast communication methods among fire service personnel, emergency service responders, and law enforcement at a simulated emergency scene. Examine protocol for radio communications, communication responsibilities of police officers at the scene, arrival and progress reports, use of tactile channels and evacuation signals, and personnel accountability reports. (TN Reading 2, 9; TN Writing 4, 9)

5) Research the Communications Assistance for Law Enforcement Act (CALEA) and debate in an argumentative essay or oral presentation how public and private communications have been affected by increased surveillance activities. (TN Reading 1, 2; TN Writing 1, 4, 9)

Contemporary Law Enforcement

6) Articulate important historical events and milestones impacting the evolution of the current law enforcement services systems in the United States. Use a timeline or other graphic to illustrate the major developments, citing specific textual evidence from research. (TN Reading 1, 2, 7; TN Writing 2, 9)

7) Gather information from emails or interviews with local law enforcement personnel, news media, and online and print law enforcement journals to investigate the range of technologies currently used in law enforcement, such as geospatial and crime mapping, body armor, forensics, officer safety and protective technologies, and sensors and surveillance technologies. Summarize how each of these technologies is being used as well as the challenges and limitations of each. (TN Reading 1, 2, 4, 7; TN Writing 7, 8, 9)

8) Research the impact that social media (such as Facebook, Twitter, and YouTube) has on law enforcement with an emphasis on the following areas: potential hazards for an officer, "police baiting," crime prevention, and criminal investigation. Draft a policy for protecting the safety of officers or citizens that addresses the issue of First Amendment rights. (TN Reading 2; TN Writing 4, 6)

Overview of Courts and the Justice Process

9) Differentiate between and provide examples of statutory law, administrative law, and the elements of an offense. Develop a comparison chart to draw connections among example laws for each type, relevant legal concepts such as burden of proof and applicable defenses and punishments. (TN Reading 2, 4, 5; TN Writing 4, 9)

10) Analyze selected laws and rules listed in the Tennessee Code Annotated. Compare a law and/or rule with similar ones from other states. Explain findings in a written, oral, or digital presentation, citing references and including title of the section, chapter, who or what the code is directed at, code numbers and name of code, when the code was originally written, and when it was last updated. (TN Reading 4, 6, 8, 9; TN Writing 6, 9)

11) Analyze transcripts of court cases; identify and explain the roles of the participants at each stage of the trial process, including the defendant's first appearance in court, arraignment, preliminary hearing, grand jury proceedings, motions by lawyers, jury selection, presentation of evidence, and opening and closing remarks. (TN Reading 2, 4; TN Writing 4, 8, 9)

12) Develop an organizational chart of all personnel within the court system required to conduct a criminal trial and a civil trial. Summarize the roles and responsibilities for each professional. Using real-time and projected labor market data, identify local and national employment opportunities and determine areas of growth. (TN Reading 2, 7; TN Writing 8, 9)

13) Explain the similarities, differences, and interactions among local, county, state, and federal courts systems. Describe how civil, misdemeanor, criminal, and felony cases progress through each court. (TN Reading 2, 9; TN Writing 9)

Due Process

14) Describe the elements necessary to conduct a lawful arrest and explain the circumstances that justify arresting an individual without an arrest warrant. Discuss the rights of individuals during the arrest process, especially in relation to the Miranda warning. ~~(TN Reading 2, 6; TN Writing 4, 9)~~

15) Differentiate between reasonable suspicion and probable cause; describe the factors used in determining probable cause. Identify the individual protections provided by the Fourth Amendment and describe in an informative narrative what can be considered a "reasonable expectation of privacy." ~~(TN Reading 2, 4; TN Writing 2, 9)~~

16) Explain what is required for a law enforcement officer to conduct a search; compare and contrast situations in which searches without a warrant are permissible. ~~(TN Reading 2, 4, 9; TN Writing 8)~~

17) Explore the constitutional rights provided to the accused by the Fifth and Sixth Amendments; discuss in groups fact-based scenarios in which an accused person's constitutional rights were violated, including situations involving juveniles, mentally incompetent individuals, and other vulnerable or non-traditional populations. ~~(TN Reading 2, 4, 9; TN Writing 8)~~

Professionalism

18) Define the term professionalism and how it relates to law enforcement personnel. Include in the definition the importance of traits such as integrity, intellect, industry, initiative, and impact and how professionalism is measured. Write an informational article for a local newspaper intended to promote a positive image of law enforcement, using the above criteria and information obtained from textbooks, professional law enforcement magazines, or professional law enforcement-related websites. ~~(TN Reading 2, 4; TN Writing 2, 8, 9)~~

19) Research news media, professional print and online sources, such as the Federal Bureau of Investigation (FBI) website, for articles surrounding the public image of law enforcement. Review at least three articles on the following topics: general image of law enforcement personnel, public perceptions of the outcomes of policing, and how to improve the public perception of law enforcement. Develop a Public Service Announcement or digital presentation that shares a specific challenge and potential solutions. ~~(TN Reading 1, 2, 9; TN Writing 6, 9)~~

20) Debate the logic surrounding the following statement on law enforcement professionalism from the *Building Trust Between the Police and the Citizens They Serve* guide, produced by the International Association of Chiefs of Police: "Crime can be reduced when community trust in law enforcement increases. That can be affected by the manner in which law enforcement professionals treat their citizens. Police departments should never tolerate excessive force or discrimination in any form." Cite studies and court rulings surrounding the issue of law enforcement's use of force. ~~(TN Reading 1, 2, 9; TN Writing 1, 4, 9)~~

21) Successfully perform American Red Cross or American Heart Association Adult, Child, and Infant Basic Life Support and first aid skills. ~~(TN Reading 3)~~

Crimes and Crime Scenes

22) Conduct a short research project using public crime statistics at the local, city, or county level. Drawing on the FBI Uniform Crime Reporting's National Crime Victimization Survey, in combination with state and local crime data, identify the prevalence of crimes related to drugs, motor vehicles, computers, and theft. Compare the retrieved data with corresponding figures at the national level; illustrate trends and other major findings in a digital presentation. (TN Reading 2, 4, 7, 9; TN Writing 7, 8, 9)

23) Using the U.S. Department of Justice Drug Enforcement Administration guide and other professional law enforcement databases, research and develop a handbook that might be used by law enforcement on illegal substances that outlines the following:
    a. Explanation of the Controlled Substance Act
    b. Drug classes
    c. Physical vs. psychological dependence
    d. Common, chemical, and/or street name of each substance
    e. Origin of substance
    f. Appearance
    g. Effects on body and mind
    h. Signs of overdose
    i. Legal status in the U.S.
    j. Procedures that should be followed when encountering an abuser
    (TN Reading 2, 3, 4, 9; TN Writing 2, 4, 8)

24) Describe the components of a police incident report and explain how it is used as a legal document. Given a scenario concerning a law enforcement incident, prepare a police report using correct terminology. For example, prepare the report for a motor vehicle accident or a robbery within a department store. (TN Reading 3, 4, 6, 7; TN Writing 4, 9)

25) Describe tactics and tools used by police during a criminal investigation (e.g., interrogations, witness interviews, line-ups, collection of physical and DNA evidence, document research, polygraph examinations). Select one investigative tool to explore in depth and write an informative narrative describing the role of the tool in the eventual outcome of a particular case. (TN Reading 4, 7; TN Writing 2, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).

- - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- *Building Trust Between the Police and the Citizens They Serve*. (2007). Retrieved from U.S. Department of Justice, Office of Community Oriented Policing Services: http://www.theiacp.org/portals/0/pdfs/buildingtrust.pdf

Criminal Justice II

Primary Career Cluster:	Law, Public Safety, Corrections, & Security
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5988
Prerequisite(s):	*Criminal Justice I* (5987)
Credit:	1
Grade Level:	11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Law, Public Safety, Corrections, & Security courses.
Programs of Study and Sequence:	This is the third course in the *Law Enforcement Services* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-law-public-safety

Course Description

Criminal Justice II is an integrated survey of the law and justice systems for students interested in pursuing careers in law enforcement and legal services. From initial crisis scenario management to arrest, transport, trial, and corrections, procedures and laws governing the application of justice in the United States are examined in detail, with special emphasis on the best practices and professional traits required of law enforcement and legal professionals. Upon completion of this course, proficient

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students will be prepared for advanced work in crime scene analysis and forensic science, and have strong knowledge and skill preparation for postsecondary or career opportunities in associated fields. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects.*

Program of Study Application

This is the third course in the *Law Enforcement Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Law, Public Safety, Corrections, & Security website at https://tn.gov/education/article/cte-cluster-law-public-safety.

Course Standards

Situational Management

1) Define the terms anger, hostility, passive, aggressive, and assertive behavior in the context of law enforcement engagement with citizens (for example, in the event of an arrest or a traffic stop). Describe the strategies that law enforcement officers use to defuse hostile situations, and reflect on the factors that could exacerbate or alleviate one such situation. (TN Reading 4; TN Writing 4, 9)

2) Research and give examples of crisis scenarios involving children, persons with mental or physical disabilities/disorders, and those with passive, aggressive, or assertive behavior. Develop a step-by-step procedure for effectively managing each of the situations, ensuring the safety of all persons involved and maintaining ethical and professional behavior. For example, analyze a situation in which a law enforcement officer must detain a young adult impaired by an illegal substance. Cite information from at least three resources such as textbooks, interviews with law enforcement or healthcare professionals, and print or digital law enforcement journals and websites. (TN Reading 1, 2, 3, 4; TN Writing 4, 8, 9)

3) Summarize in an informative essay major theories surrounding crisis negotiations. Discuss a range of considerations in the negotiation of a crisis, including but not limited to communications techniques and styles, hostage safety, public safety vs. individual safety in a hostage situation, and safety of law enforcement personnel. (TN Reading 2, 8, 9; TN Writing 2, 9)

4) Define what constitutes bullying according to the Tennessee Department of Education School Safety Center. Relate this definition to situations when law enforcement is authorized to become involved. Describe laws that have been developed to identify and prosecute suspects of bullying. Develop a public service announcement highlighting strategies for middle and high school students to combat bullying. (TN Reading 1, 8, 9; TN Writing 6, 8, 9)

5) Describe in an oral or written presentation the characteristics of victims of domestic violence and child or elder abuse. Identify legal and confidentiality considerations, techniques for interviewing suspected victims, and resources available to seek support for victims. (TN Reading 1, 2, 4, 8; TN Writing 4, 9)

6) Role-play in a lab or classroom setting the techniques of effective crowd management, including but not limited to deployment of crowd control methods, use of force continuum, and regulations related to the use of deadly force. (TN Reading 2, 3; TN Writing 8, 9)

7) Outline law enforcement roles and responsibilities in threats of natural disaster and potential terrorism, addressing at minimum the following elements: disaster preparedness, bomb threats and suspicious objects or persons, protection of citizens, and safety of law enforcement personnel. (TN Reading 1, 4, 9; TN Writing 4, 9)

Civil Laws

8) Citing laws and legal documents, outline the responsibilities of law enforcement personnel in civil law procedures for serving writs, warrants, and summons, including areas of attachment, garnishment, claim, and delivery. (TN Reading 1, 6; TN Writing 8, 9)

9) Investigate law enforcement personnel limits on the use of force and entry into/onto private property during civil process services. Document the relevant procedure for a specific situation, such as in the Soldal v. Cook County, Illinois, case. (TN Reading 1, 2, 8; TN Writing 7, 9)

Alcohol and Beverage Laws

10) Define alcoholic beverages and differentiate between legal and illegal alcohol sales. Cite state laws to support analysis of the differences. (TN Reading 1, 2, 8; TN Writing 8, 9)

11) Investigate organizations that have formed over the past century to combat the negative effects of alcohol abuse in teens and adults. Relate how legislation and law enforcement practices have changed due to the efforts of these organizations. (TN Reading 1, 8, 9; TN Writing 7, 8, 9)

12) Research laws and procedures utilized by law enforcement to address offenses for driving while intoxicated and driving under the influence. Compile the research into an oral, visual, or digital presentation, citing landmark cases upholding these laws. (TN Reading 2, 7; TN Writing 6, 9)

13) Research the National Highway Traffic and Safety Administration (NHTSA) safety desk book for guidelines related to alcohol and drug-impaired driving. Document, according to law enforcement guidelines, the possible outcomes of the preliminary breath testing device and the three Standardized Field Sobriety Tests of horizontal gaze nystagmus, walk-and-turn, and one-leg stand. (TN Reading 1, 2, 3, 4, 9; TN Writing 4, 5, 8, 9)

Arrest and Transport

14) Devise a written plan for completing the search of a suspect without violating the individual's rights according to Tennessee state search and seizure laws. Drawing on case studies or police training videos, role-play search and seizure procedures in a classroom/lab setting. (TN Reading 1, 3, 4; TN Writing 4, 9)

15) Interpret acceptable procedures for transporting a person without violating his or her personal rights and maintaining safety for everyone involved. Debate how these procedures might

require modification for juveniles, persons impaired with mental/physical diseases and disorders, and any other special population. ~~(TN Reading 2, 4, 9; TN Writing 9)~~

16) Summarize interrogation techniques used by law enforcement personnel as influenced by John E. Reid. Demonstrate in a role-play scenario each of the interrogation techniques while maintaining the constitutional rights of suspects and victims. ~~(TN Reading 1, 3, 4)~~

Courts and the Criminal Trial Process

17) Compare and contrast the specific state and federal laws and ethical issues that affect relationships among defendants and law enforcement professional, and debate these issues in an oral or written format. Discuss the application of professional/ethical codes and standards of practice. ~~(TN Reading 2, 9; TN Writing 1)~~

18) Examine a criminal trial case. Identify the procedures related to the testimony of the witnesses: what rules of questioning must be followed by the lawyers, what the definition of an expert witness is, who can testify, the circumstances under which testimony is deemed factual, and what qualifies as perjury. ~~(TN Reading 2, 4, 8; TN Writing 8, 9)~~

Initial Response to Crime Scene

19) Conduct a systematic search of a simulated crime scene. Develop a sketch using triangulation, rectangular coordinates, straight-line methods, and transecting baseline coordinates following law enforcement industry standards for gathering evidence. (Include measurements, compass directions, scale of proportion, legend, key, and title.) Explain components of the search to classmates as if presenting to a jury. ~~(TN Reading 2, 3, 4)~~

20) Identify the common types of physical evidence, explain acceptable parameters for determining significance, and provide cautions and limitations when dealing with evidence. ~~(TN Reading 2, 3, 5)~~

Corrections

21) Articulate important historical events and milestones impacting the evolution of the penal system in the United States. Compile a timeline or other graphic to illustrate major developments from the colonial period to today, citing specific textual evidence from research. ~~(TN Reading 1, 2, 7; TN Writing 2, 9)~~

22) Compare and contrast the various types of public and privately owned jails/prisons at the local, regional, state and federal levels. In an informational essay, provide an overview of the prison systems in the state (including local, state, and federal) that includes the following institutional characteristics: the types of prisoners housed, maximum capacity, staffing requirements, safety measures in place, levels of security or other distinguishing characteristics, and training requirements for staff (both pre-employment and professional development). ~~(TN Reading 1, 2, 8; TN Writing 4, 9)~~

23) Explain the structure of the juvenile detention system in Tennessee. Develop an argumentative essay on the efforts underway in the state to address the problem of disproportionate

confinement, and evaluate the effectiveness of such efforts to date by developing appropriate claim(s) and counterclaim(s). ~~(TN Reading 2, 5; TN Writing 1, 4)~~

24) Explore the origins of parole, probation, and community corrections. Define each term and explain the interrelationships among the concepts, addressing the role of law enforcement and relevant social issues in criminal justice. ~~(TN Reading 2, 4,)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Criminal Justice III: Investigations

Primary Career Cluster:	Law, Public Safety, Corrections, & Security
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code(s):	5989
Prerequisite(s):	*Criminal Justice II* (5988)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Law, Public Safety, Corrections, and Security courses.
Programs of Study and Sequence:	This is the final course in the *Law Enforcement Services* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-law-public-safety

Course Description

Criminal Justice III: Investigations is the final course designed to equip students with the knowledge and skills to be successful in the sciences of criminal investigations. Students will learn terminology and investigation skills related to the crime scene, aspects of criminal behavior, and applications of the scientific inquiry to solve crimes. By utilizing the scientific inquiry method, students will obtain and

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analyze evidence through simulated crime scenes and evaluation of case studies. Upon completion of this course, proficient students will be able to identify careers forensic science and criminology, summarize the laws that govern the application of forensic science, and draw key connections between the history of the forensic science system and the modern legal system. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the fourth and final course in the *Law Enforcement Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Law, Public Safety, Corrections, and Security website at https://tn.gov/education/article/cte-cluster-law-public-safety.

Course Standards

Scope and Development of Forensic Science

1) Articulate important historical events and contributors impacting the evolution of forensic science and crime scene investigation in the United States. Use a timeline or other graphic to illustrate the major developments from the 16th century to today, citing specific textual evidence from textbooks, online and print journals, and other websites. Include any legislation that mandates the practice of forensic science. ~~(TN Reading 1; TN Writing 2, 9)~~

2) Define the term Criminalistics. Research a case study that involved a criminalist and report on how his/her involvement in the case made a difference in the outcome. Cite evidence from textbooks, online and digital professional journals, and case studies to support claims. Include not only physical evidence analysis but also the application of physical and natural sciences. ~~(TN Reading 1, 2, 6, 8; TN Writing 4, 8, 9)~~

3) Describe the eleven sections of forensic science as defined by the American Academy of Forensic Science, and discuss associated laws that guide scientific work in forensics. Develop a visual or graphic presentation to explain the roles and functions of each and relate to law and public safety careers studied in previous courses. ~~(TN Reading 1, 4; TN Writing 6, 9)~~

4) Develop an argumentative essay that makes a claim about the influence of media on the practices of crime investigations, citing a specific trial and the investigation leading up to it. Discuss the differences between the gathering and presenting of crime scene evidence and the depiction of that system in movies and television. Develop claim(s) and counterclaim(s) without prejudice, supplying data and text-based evidence from sources consulted. ~~(TN Reading 1, 2, 8, 9; TN Writing 1, 4, 9)~~

5) Citing information found on websites in the forensic links section of the American Academy of Forensic Science, news media, and legislation, describe the evolution of the modern crime laboratory. Discuss the features of present-day crime labs, including the differences between public and private. Explore how they have changed law enforcement and the conviction of criminals, their services and capabilities, and the new or emerging technologies they use. ~~(TN Reading 1, 7, 9; TN Writing 4, 8, 9)~~

Career Planning

6) Using the American Academy of Forensic Science and Young Forensic Scientist Forum, investigate occupations within forensic science. Demonstrate an understanding of each occupation by accurately articulating the following:
   a. Roles and responsibilities of the position
   b. Comparison of similar careers available in local, state, federal, and military systems
   c. Educational, training, and certification requirements
   (TN Reading 1; TN Writing 7, 8, 9)

7) Develop a career profile for at least three occupations related to forensic science and criminal investigations, using print, online, and/or personal interview sources to capture at minimum the following:
   a. Job description
   b. Essential knowledge and skills needed for the career
   c. Program or path of study to reach occupational goals, beginning with high school and proceeding through postsecondary
   d. Licensure and credentialing requirements
   e. Non-educational job requirements such as physical fitness tests, minimum age, and psychological evaluations
   (TN Reading 2; TN Writing 4, 9)

Elements of Investigation

8) Identify emerging technologies and techniques being utilized by law enforcement while gathering and processing evidence at a crime scene and in the laboratory. Review a current or recent court case that utilized one of these technologies or techniques. Write an argumentative essay debating if the technology could be an infringement on the defendant's rights. An example would be maintaining a database of DNA from birth. (TN Reading 2, 4; TN Writing 1, 8, 9)

9) Explain the law enforcement officer's roles and responsibilities at a crime scene and the elements of preserving and recording the crime scene; incorporate knowledge gained in previous courses related to search and seizure of persons, property, and evidence. Photograph, sketch, and make notes of a simulated crime scene to permanently record the scene following law enforcement acceptable standards. Document findings with adherence to law enforcement standards using acceptable terminology. (TN Reading 3; TN Writing 4)

10) During a systematic search of a simulated crime scene, identify physical evidence. Demonstrate the legal and acceptable methods for collecting, packaging, and preserving evidence, using the appropriate procedures and tools. (TN Reading 2, 3, 5; TN Writing 9)

11) Define the term "chain of evidence". Review a court case in which the chain of evidence was not followed, and explain the legal ramifications if the chain is disrupted; consider steps to prevent evidence being excluded from a case. (TN Reading 2, 4; TN Writing 9)

Physical Evidence Analysis

For each of the standards in this section, evaluate court case studies related to each concept.

12) Investigate the science surrounding the physical properties of matter, and explain how they are related to the role of the law enforcement officer when collecting evidence. Apply the principles of temperature, weight and mass, density, and refractive index in the context of forensic science. (TN Reading 4; TN Writing 4; TN Math N-Q)

13) Explain the physical composition of glass and relate the characteristics of various types such as tempered and laminated. Demonstrate the skill of identifying the classifications of glass fragments, and calculate the projectile path by examining glass fractures at a simulated scene. (TN Reading 1, 2, 3, 4; TN Math N-Q)

14) Examine the forensic tools used in a field sobriety test and a blood alcohol test, and describe legal guidelines that must be followed when performing each of these tests as they relate to the constitutional rights of suspects. Evaluate concepts of toxicology and metabolism of alcohol, and determine the effects of alcohol on persons of different weights, ages, and genders. (TN Reading 1, 3, 4, 9; TN Writing 4, 9)

15) Evaluate a death related to chemicals that can be harmful or poisonous to the human body, such as drugs or carbon monoxide. Describe the process for collecting and preserving toxicology evidence and the techniques used for detecting the type of substance. (TN Reading 2, 4; TN Writing 4, 9)

16) Analyze the scientific basis of tests performed on various body fluids and/or stains at a crime scene to determine their origins. Demonstrate collection of simulated body fluids from a staged crime scene to preserve and prevent contamination of the sample. Include in the demonstration compliance with OSHA standards of practice when dealing with blood and body fluids. (TN Reading 2, 3, 4; TN Writing 4)

17) Describe the techniques used to excavate bones from a crime scene and the methods for distinguishing human bones from animal bones. Identify the parameters for determining the age, sex, and possible ethnicity of a human skull. (TN Reading 1, 3, 8; TN Writing 4)

18) Review an autopsy report to determine the time and cause of death through evaluation of body temperature, rigor mortis, post mortem lividity, appearance of eyes, skin color, and presence of entomology. Document findings in an informative essay or other report. (TN Reading 1, 2, 8; TN Writing 2)

19) Debate in a written or oral presentation how DNA testing and the Combined DNA Index System (CODIS) have changed the criminal justice system, citing evidence from professional print or digital journals, case studies, court cases, or interviews with law enforcement or forensic scientists to develop claim(s) and counterclaim(s). (TN Reading 1, 2, 9; TN Writing 1, 4, 9)

20) Document the interpretation of a simulated bloodstain pattern, including the following information:
    a. Data gathered from pattern analysis concerning the violent event
    b. Impact of surface texture, directionality, and angle on pattern

c. Calculation of angle of impact
d. Methods to determine the area of convergence and area of origin for impact spatter patterns
e. Whether the spatter is classified as a low-, medium-, or high-velocity impact spatter
f. How the pattern was created and distinguishing features
g. Type of spatter
(TN Reading 1, 2, 3, 4; TN Writing 4, 7, 8, 9; TN Math N-Q)

21) Compare and contrast the physical and microscopic properties of human hair vs. animal hair. Demonstrate the skills of collecting and preserving hair evidence at a simulated crime scene. (TN Reading 3)

22) Explain the automated fingerprint identification system (AFIS), why it was developed, and how it is currently being utilized in law enforcement. Demonstrate the procedure for detecting fingerprints, developing latent prints, and preserving developed prints. (TN Reading 2, 4; TN Writing 2, 4)

23) Identify the recognizable characteristics, from bullets and cartridge casings, at a staged crime scene or from a case study. Explain in a graphic presentation how these characteristics are placed in the National Integrated Ballistics Information Network and the uses of the network by local, state, and federal law enforcement. (TN Reading 2, 4; TN Writing 6)

24) Research the concepts surrounding bullet trajectory and its uses in criminal investigations for determining victim and suspect locations and movements at a crime scene. Prepare a professional written report summarizing this information. (TN Reading 1, 2, 3, 4; TN Writing 2, 4, 5, 7, 8, 9; TN Math N-Q)

25) Compare and contrast the various forensic techniques used at a crime scene and in the laboratory to determine gunpowder residue, shoe prints, tool marks, tire marks and bite marks. Provide a full explanation of each test. (TN Reading 2, 4; TN Writing 4, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.

- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Court Systems and Practices

Primary Career Cluster:	Law, Public Safety, Corrections, & Security
Consultant:	Candi Norwood, (615) 532-6248, Candi.Norwood@tn.gov
Course Code:	6150
Prerequisite(s):	*Criminal Justice I* (5987)
Credit:	1 or 2*
Grade Level:	11-12
Graduation Requirements:	This course satisfies one or two* of three credits required for an elective focus when taken in conjunction with other Law, Public Safety, Corrections, & Security courses.
Programs of Study and Sequence:	This is the capstone course in the *Legal and Correction Services* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	590, 750
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-law-public-safety

Standards marked with an asterisk (*) serve as extension standards to be taught if course is offered for two credits.

Approved April 10, 2015; Amended April 15, 2016

Course Description

Court Systems and Practices is the fourth and final course in the *Legal and Correctional Services* program of study for those students who are interested in the legal aspects of law, public safety, and corrections. This course can be taught for one or two credits, at the discretion of the instructor. Upon completion of this course, proficient students can identify careers in legal and correctional services, evaluate legal documents as they pertain to the rights of citizens outlined in the U.S. Constitution, and analyze the criminal court system process from arrest to parole. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts and Literacy in Technical Subjects and Tennessee State Standards in Mathematics.**~~

Program of Study Application

This is the fourth and final course in the *Legal and Correctional Services* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Law, Public Safety, Corrections, & Security website at https://tn.gov/education/article/cte-cluster-law-public-safety.

Course Standards

Careers in Legal Services and Corrections

1) Research careers within Legal and Corrections Services; identify educational requirements as well as applicable licensure or credentialing requirements for specific occupations. Compare the range of skills, competencies, and professional traits required of professionals in Legal and Corrections Services. ~~(TN Reading 2; TN Writing 4, 7, 9)~~

2) Prepare a career profile for at least one occupation in each of the four career areas in the cluster, using print, online, and/or personal interview sources to capture at minimum the following:
   a. Job description
   b. Essential knowledge and skills needed for the career
   c. Program or path of study to reach occupational goals, beginning with high school and proceeding through postsecondary
   d. Licensure and credentialing requirements
   e. Non-educational job requirements such as physical fitness tests, minimum age, and psychological evaluations
   ~~(TN Reading 1, 2; TN Writing 4, 7, 9)~~

3) Using real-time and projected labor market data, identify local, state, and out-of-state employment opportunities and potential earnings. Investigate occupations within the pathways that are projected to experience growth. Explore postsecondary education and training options for positions in the field. ~~(TN Reading 1, 2, 7, 9; TN Writing 4, 7, 9)~~

4) Compare and contrast specific laws and rules of ethics that govern relationships among the accused and the professionals with whom they interact in the legal and corrections systems. Explore one issue (such as confidentiality, conflicts of interest, advertising, referral fees, barratry, solicitation, failure to disclose exculpatory evidence, and bribery), developing claim(s)

and counterclaim(s) to craft an argument about current practices impacting public safety professionals. (TN Reading 1, 2, 4, 6, 8; TN Writing 1, 4, 7, 9)

5) *Evaluate factors that contribute to effective communication between professionals and their clients, including demonstrating sensitivity to privileged conversations, language barriers, cultural differences, and individuals with special needs. Compare effective practices appropriate for an office, police station, or classroom setting. (TN Reading 2, 6)

Overview of Courts and the Criminal Justice Process

6) *Construct an argumentative essay developing a claim about how the U.S. Constitution, the Bill of Rights, and landmark cases such as Miranda v. Arizona, Weeks v. United States, Mapp v. Ohio, and/or Escobedo v. Illinois have affected the criminal justice system and legal professionals in particular. (TN Reading 1, 2, 6, 9; TN Writing 1, 4, 5, 7, 9)

7) Review the history of American court systems and create a graphic organizer illustrating the role of the courts at the local, county, state, and federal levels. (TN Reading 2, 9; TN Writing 4)

8) Describe the functions of the state, federal, and military court systems in criminal proceedings; compare and contrast the subject matter jurisdiction of each system, identifying where the systems overlap; explain venue and how it is determined. (TN Reading 2, 4, 5; TN Writing 4, 9)

9) *Explore the different ways public opinion and elected officials can affect the criminal justice process; construct a hypothetical case that includes several examples of how public opinion and/or the decisions of elected officials impacted the outcome or deliberation of professionals involved in the case. (TN Reading 2, 6; TN Writing 4, 9)

Legal Process

10) *Define temporary detention; discuss the circumstances law officers must identify to detain an individual as well as to conduct a frisk. Review the Landmark Supreme Court decision Terry v. Ohio and debate the "stop and frisk" tactics used over the last decade by the New York Police Department. (TN Reading 2, 3, 4, 6, 8; TN Writing 2, 4, 7, 9)

11) Identify the individual protections provided by the Fourth Amendment and describe in an informative narrative what can be considered a "reasonable expectation of privacy." (TN Reading 2, 4; TN Writing 2, 4, 9)

12) *Review the Exclusionary Rule and explain in an oral argument or written narrative how it applies to the Fourth Amendment (Mapp v. Ohio) and the Fifth Amendment (Miranda v. Arizona). Describe the relationship of the fruit of the poisonous tree doctrine to the exclusionary rule (Silverthorne Lumber Co. v. United States). (TN Reading 2, 5, 6; TN Writing 2, 4, 9)

13) Explore the landmark case New Jersey v. T.L.O., and discuss in groups the expectations by students of privacy on school property with respect to search and seizure. (TN Reading 1, 2)

14) *Identify rights provided in the Miranda warning and the circumstances under which officers and other corrections authorities are required to read them to an arrested person. Analyze the

possible outcomes in a criminal case in the event the Miranda Warning is not given at the time of interrogation. Explore situations in which rights may be delayed or waived, for example, if the suspect is considered an "enemy combatant." (TN Reading 2; TN Writing 4)

15) Define what constitutes an arrest. Based on provided fact patterns, identify the exceptions to the constitutional requirement of obtaining an arrest warrant. (TN Reading 2, 6; TN Writing 4, 9)

16) Analyze how technological advances are changing the landscape of police surveillance and discuss potential legal and ethical issues that could arise as technology continues to evolve. (TN Reading 1, 2, 6, 8; TN Writing 4, 9)

Pre-Trial Proceedings

17) Explain the sequence of court proceedings that comprise the pre-trial process (e.g., booking, arraignment, bail reviewed/set, complaint filed/grand jury indictment, preliminary hearing, pre-trial discovery, challenges to evidence, pre-trial hearing). Select several steps to simulate in the classroom and assign the role of the accused, prosecutor, judge, defense attorney, and police for role-play or debate. (TN Reading 2, 4, 9; TN Writing 4, 9)

18) Define the role of a Grand Jury in felony cases; locate the instructions provided to citizens summoned for Grand Jury duty in your county/state; review the Handbook for Federal Grand Jurors; write a narrative contrasting the role of Grand Jurors with the role of a Trial Juror. (TN Reading 2, 4, 5; TN Writing 4, 7, 9)

19) *Review the procedures associated with plea bargains and identify the types of pleas. In groups, argue the advantages and disadvantages of negotiating a plea bargain from both the defendant's and prosecutor's viewpoints, developing claim(s) and counterclaim(s) with data, evidence, and sound reasoning. (TN Reading 2, 4; TN Writing 1, 4, 9)

20) Describe the bail process, identifying types of bonds, factors that influence bail amount, and factors that permit the denial of bail. Explore alternatives to bail including options made possible by advances in technology. (TN Reading 2, 4; TN Writing 4, 9)

Trial

21) Review and identify the types of evidence that can be presented in a criminal trial. Differentiate among the various types of evidence and identify which party (defense or prosecution) has the burden of proof, including the defendant's burden to prove the defense claimed. (TN Reading 2, 4; TN Writing 4, 9)

22) Explain in a narrative the purpose and types of motions and challenges to evidence, including the different elements of a motion and how they are organized. Draft an example of a motion to suppress evidence. (TN Reading 2, 4, 5; TN Writing 2, 4, 9)

23) Describe how a jury is selected for a criminal case. Explain in a narrative the *voir dire* process, providing examples of situations in which a juror can be dismissed for cause and describing how an attorney might use his or her peremptory challenges to benefit the client. (TN Reading 2, 4, 9; TN Writing 2, 4, 7, 9)

24) Research and identify Supreme Court decisions (such as Batson v. Kentucky) related to a line of rulings barring the use of race, ethnicity, and other characteristics as a basis for excluding potential jurors. Debate as a class the advantages and disadvantages of the "jury of your peers" system in America. (TN Reading 1, 2; TN Writing 1, 4, 7, 9)

25) Describe the role of witness testimony in a criminal trial, including such areas as exchange of information/communication between attorneys, the rules of discovery, and the laws and/or rules of ethics governing communication between witnesses and attorneys. (TN Reading 2; TN Writing 4)

26) Investigate news media and professional commentary on how the "CSI Effect" (televised forensic science) has affected the criminal justice system, including a juror's decision making. Debate in groups whether or not the differences between the portrayal of the justice system in popular media and how the system actually operates have impacted the system's ability to function effectively. (TN Reading 2, 4, 7; TN Writing 1, 4, 9)

Sentencing

27) Prepare an informative narrative describing the range of sentencing options in criminal trials at the federal and state levels. Identify the roles of the judge and jury in the decision-making process for each of the options noted. (TN Reading 2, 4; TN Writing 2, 4, 9)

28) Argue the pros and cons of indeterminate sentencing; research current sentencing trends in Tennessee and their perceived or documented effects on prisoner behavior. (TN Reading 1, 2, 8; TN Writing 1, 4, 7, 9)

29) Explain the options for alternative sentencing in criminal case convictions and identify the length of sentences available for alternative sentencing in Tennessee. (TN Reading 2; TN Writing 4)

30) *Research Tennessee legislative activity over the past decade with respect to juvenile offenders. Identify major legislation passed and analyze what these trends signify for the local justice system. (TN Reading 2; TN Writing 4, 9)

31) Identify landmark Supreme Court decisions that have addressed issues of racial discrimination and sentencing. Explore the effects of at least one decision on the sentencing outcome of a criminal case. (TN Reading 1, 2; TN Writing 4, 7, 9)

Appeals

32) Define what constitutes an appeal, who can file it, and at what point it can occur; explain the right to an appeal and which court decisions, at what level, are eligible for appeal. Differentiate between a traditional and interlocutory appeal. (TN Reading 2, 4, 5; TN Writing 4)

33) *Construct a graphic organizer to demonstrate the appeals process in the state or federal court system, identifying the roles of the appellant and appellee, the role of the appellate brief, and the stages of review. (TN Reading 2, 4; TN Writing 4)

34) Review the components of an appellate brief and draft an outline for a brief based on a fact-based scenario. (TN Reading 2, 5; TN Writing 4)

Punishment

35) Outline the common models of corrections used in the U.S. since 1900, identifying recurring trends and major reform movements in the 21st century. (TN Reading 2; TN Writing 4)

36) Through research, identify the offense with the highest percentage of convicted criminals currently incarcerated in Tennessee's prison system. Identify the average sentence length and analyze trends in incarceration rates in Tennessee over the past decade. (TN Reading 1, 2, 7; TN Writing 4, 7, 9)

37) *Calculate the costs associated with investigating, arresting, prosecuting, sentencing, and housing someone who has committed a felony. (TN Reading 7, 9; TN Writing 4, 7, 9)

38) *Research and evaluate the effects of public policy organizations such as the Innocence Project on public perception of the criminal justice system and the importance of DNA evidence in criminal investigations, and the ability of organizations outside the legal system to drive reform of the legal system. (TN Reading 1, 2, 6, 9; TN Writing 4, 7, 9)

Detention

39) Prepare a chart of the federal and state prisons and county jails in Tennessee, detailing special services or populations served and the level of security at each. Choose one institution (such as the women's state prison or the federal prison) and compare and contrast services provided at that institution to those provided at other prison facilities. (TN Reading 2, 7, 9; TN Writing 4, 6, 7, 9)

40) *Explain the structure of the juvenile detention system in Tennessee; explore efforts underway in the state to address the problem of disproportionate confinement. (TN Reading 2; TN Writing 4)

41) Search for interview transcripts, video documentation, or other published primary and secondary sources detailing first-hand testimony of contemporary prison culture and determine how it is affected by the size and security level of the prison or the types of crimes committed by inmates. (TN Reading 7, 9; TN Writing 4)

42) Cite example cases whose decisions affected the rights incarcerated individuals. Describe basic prisoner rights protected by the Constitution. (TN Reading 1, 2, 9; TN Writing 2, 4, 7, 9)

43) *Investigate the Rules of the Tennessee Corrections Institute related to correctional facilities inspection and explain some of the minimum standards for local jails and detention facilities, addressing categories such as security, discipline, administration, medical services, and food services. (TN Reading 2, 4, 5; TN Writing 2, 4, 7, 9)

44) *Research at least three issues county correctional facilities in Tennessee are currently facing; identify contributing factors for each issue and debate a range of policy changes that could potentially mitigate current areas of concern. Example topics could include state reimbursement issues and support for individuals with mental health conditions. (TN Reading 1, 2, 6, 9; TN Writing 1, 4, 7, 9)

Parole and Probation

45) Explore the origins of parole, probation, intermediate sanctions and community corrections. Define each term and explain the interrelationship of the concepts, addressing both law enforcement and social issues in criminal justice. Debate contemporary issues in the field including growing caseloads for probation officers, use of evidence-based practices, and the changing landscape of community corrections. (TN Reading 2, 4, 8, 9; TN Writing 1, 4, 7, 9)

46) *Investigate data resources available through government and nonprofit sources on issues related to parole, probation, and intermediate sanctions; review research data available from the Bureau of Justice Statistics and analyze trends and success rates in the overall community supervision population. (TN Reading 7, 9; TN Writing 4, 8, 9)

47) Describe the purpose of post-release/re-entry programs and provide specific examples of programs available in Tennessee to assist ex-offenders as they return to society. Select one program and study its impact (both advantages and disadvantages) on former prisoners and communities over the past 5-10 years. (TN Reading 2, 7; TN Writing 2, 4, 7, 9)

*Capstone Project

A mock trial offers students the opportunity to role-play what might take place in a trial court. Typically, teams of students work together to prepare presentations from provided case materials. Students study the materials, develop their case, prepare witnesses for examination, and draft opening statements and closing arguments. The students assume the roles of attorneys and witnesses and are prepared to argue either side of the case. Professionals from the legal field often serve as judges. Most commonly, students are evaluated on the ability to make a logical, cohesive, and persuasive presentation. This experience hones a student's critical thinking, research, writing, and public speaking skills in addition to strengthening his or her ability to work effectively in teams. In this course, the **Pre-trial** and **Trial** section topics offer the most practical opportunities to integrate a mock trial experience. *The capstone project requires synthesis and demonstration of course knowledge and skills and includes research, analysis, reflection, and revision opportunities required for meeting all of the grade 12 TN Reading and Writing standards.*

Standards Alignment Notes

**References to other standards include:

- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Marketing and Management I: Principles

Primary Career Cluster:	Marketing
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5931
Prerequisite(s):	None
Credit:	1
Grade Level:	10 - 11
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Marketing courses. In addition, it satisfies the economics requirement for graduation.
Programs of Study and Sequence:	This is the second course in the *Marketing Management* and *Entrepreneurship* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are local dual credit/dual enrollment opportunities for this course, including Volunteer State Community College and Middle Tennessee State University.
Teacher Endorsement(s):	030, 035, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-marketing

Course Description

Marketing and Management I: Principles focuses on the study of marketing concepts and their practical applications. Students will examine the risks and challenges that marketers face to establish a competitive edge in the sale of products and services. Topics covered include foundational marketing functions such as promotion, distribution, and selling, as well as coverage of economics fundamentals, international marketing, and career development. Upon completion of this course, proficient students

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will understand the economic principles, the marketing mix, and product development and selling strategies. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee state standards in Economics.*~~

Program of Study Application

This is the second course in the *Marketing Management* and *Entrepreneurship* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Marketing website at https://tn.gov/education/article/cte-cluster-marketing.

Course Standards

Role of Marketing

1) Define marketing and describe the marketing benefits derived from each economic utility (form, time, place, possession, and information). Discuss how each benefit adds value to products and services. ~~(TN Reading 2, 4, 5; TN Writing 4; TN Economics 2)~~

2) Describe each marketing core function (i.e., channel management, marketing information management, market planning, pricing, product service management, promotion, and selling) and supply examples of how each of these functions support the marketing concept. ~~(TN Reading 2, 4, 5; TN Writing 4)~~

Marketing Mix

3) Examine the marketing mix; select a product or service and construct a visual representation with details and examples illustrating each of the four P's (product, place, price, and promotion) of that particular product or service. ~~(TN Reading 1, 7, 9; TN Writing 4)~~

4) Analyze the elements of a marketing plan and retrieve sample templates or exemplars from real companies (use local sources or Internet searches of prominent businesses). Discuss common elements of each marketing plan and identify the different objectives that the companies outlined in each plan, citing specific textual evidence. ~~(TN Reading 1, 6, 8, 9; TN Writing 8, 9)~~

5) Explain the concept of market segmentation. Cite textbook(s) and case studies in a discussion of how market segmentation is used as a company strategy to increase its market share. ~~(TN Reading 1, 2, 9; TN Economics 1, 3)~~

6) Conduct a SWOT analysis on a company and/or student organization, identifying its most significant strengths, weaknesses, opportunities, and threats. Highlight the techniques or specific results of market segmentation by including demographic, psychographic, and geographic data in the analysis. ~~(TN Reading 5; TN Writing 4, 7; TN Math N-Q; TN Economics 1, 3)~~

7) Using the same company as in the SWOT analysis, produce a marketing plan with the objective of increasing the company's market share by targeting a non-traditional customer. Outline specific marketing strategies, implementation plans, and evaluation standards. Explain the

measures that will be used to quantify and/or qualify the results of plan implementation (e.g., employing website metrics to track the response rate for a fundraising campaign). (TN Writing 2, 4, 7)

Economics

8) Explain the concept of economy, delineating between micro and macroeconomic principles, and discuss how scarcity and factors of production require nations to make economic choices. Compare and contrast how the various economic systems (traditional, market, command, mixed) try to answer the questions: "What to produce? How to produce it? For whom to produce?" (TN Reading 2, 5, 6, 7; TN Writing 2, 4, 9; TN Economics 2, 4)

9) Explain how the following economic indicators are used in a market economy for business analysis and marketing decisions: gross domestic product (GDP), standard of living, inflation rates, interest rates, unemployment rate, productivity rates, stock market reports, and consumer price index (CPI). Demonstrate the ability to retrieve and interpret figures from public websites such as the International Monetary Fund (IMF), World Bank, and the Federal Reserve System in order to assess the overall economic health of nations and markets. (TN Reading 1, 2, 4, 5, 7; TN Writing 2, 4, 8, 9; TN Math N-Q; TN Economics 2, 4)

10) Produce a graphic illustration of the business cycle (recession, depression, recovery, and peak) and describe what happens to the economy at each stage of the business cycle. Cite examples of businesses that could flourish in each stage of the cycle. (TN Reading 2, 4; TN Writing 6, 9; TN Economics 2, 4)

11) Explain the characteristics of the free enterprise system. Argue for or against the claim that private ownership, competition, risk, and the profit motive benefit society. Critique the arguments of others and cite evidence to develop original claim(s) and counterclaim(s). (TN Reading 2, 4, 8; TN Writing 1, 9; TN Economics 2, 4)

12) Distinguish between price and non-price competition; provide five non-price examples of competition for customers. (TN Reading 4; TN Writing 4)

13) Explain the theory of supply and demand by diagramming a recent purchase of both an elastic and non-elastic product. Use the price paid at the time of the purchase as the equilibrium price; show the impact on price due to an increase or decrease in demand or supply. (TN Reading 7; TN Writing 4; TN Math N-Q; TN Economics 2, 4)

14) Explain the role of government in the private enterprise system. Identify federal regulatory agencies and laws that protect workers. Cite textual evidence from news media or textbook(s) to support an identification of examples of events that led to the creation of a specific piece of legislation and how changes in laws impact trade with both domestic and foreign customers. (TN Reading 1, 2; TN Writing 2, 4, 7, 9; TN Economics 2, 4)

International Marketing and the Global Marketplace

15) Discuss the concept of U.S. protectionism and cite a recent example from news media in which this principle has been referenced, critiqued, or defended. Identify major trade barriers and trade alliances, such as the North American Free Trade Agreement (NAFTA), and craft an original argument for or against U.S. protectionism. Support reasoning with evidence and make recommendations to maintain or remove sanctions affecting a given industry or country. ~~(TN Reading 1, 2; TN Writing 1, 4, 9; TN Economics 1, 2, 4, 5)~~

16) Understand the impact of international organizations and treaties, including but not limited to the North American Free Trade Agreement (NAFTA), World Trade Organization (WTO), General Agreement on Tariffs and Trades (GATT), and the European Economic Community (EEC). Explain the benefits to nations derived from forming these associations, and discuss whether benefits flow equitably to all countries involved. ~~(TN Reading 1, 2, 8; TN Writing 2, 4, 9; TN Economics 1, 2, 4, 5)~~

17) Conduct a global environmental scan by selecting a country and identifying a high-growth industry within that country. Create a new product customization or adaption not currently on the local market. Support product innovation based on research gathered through the scan. ~~(TN Reading 1; TN Writing 4, 7, 9; TN Economics 1)~~

Distribution and Channel Management

18) Describe the major modes of transportation involved in the distribution of goods, including advantages and disadvantages of each, and identify the types of products best suited for delivery via each mode of transportation. ~~(TN Reading 2; TN Writing 4)~~

19) Cite examples of how retail institutions' delivery and distribution channels in other countries differ from those in the United States. Determine how recent technological advancements have impacted the operations of warehouses and distribution centers and illustrate the challenges that still exist in developing countries. ~~(TN Reading 1, 2; TN Writing 7, 9; TN Economics 1, 2, 3, 4, 5)~~

Selling

20) Explain feature/benefit selling. Break down a selected product into the features and benefits most likely to resonate with a target population, and translate five product features into five customer benefits. ~~(TN Reading 1, 4; TN Writing 4)~~

21) Role-play the position of sales associate to a fellow classmate posing as a customer. Prepare a mock sales demonstration using the AIDA approach (Attention, Interest, Desire, and Action) while taking one's customer through the following steps:
   a. Identify the approach
   b. Determine needs
   c. Present the product
   d. Overcome the objections
   e. Close the sale (using a variety of purchase options: cash, credit, layaway)

f.　Offer suggestive selling
　　　g.　Relationship management
(TN Reading 3)

22) Explore customer relationship management strategies by formally or informally interviewing managers or other employees at local businesses. Draft a plan for maintaining and strengthening a company's relationship with its customers by identifying frequency and types of contacts, value-added services to be offered, and other activities, including social media marketing, aimed at improving customer satisfaction, loyalty, and advocacy. (TN Reading 1, 2, 6, 8; TN Writing 4, 8, 9)

Product Development, Branding, Packaging, and Labeling

23) Describe the process of new product and/or service development, including what marketing activities must occur prior to product launch. Design a chart illustrating the key steps (e.g., idea generation, screening, development, testing, introduction, and evaluation of customer acceptance) in new product development. (TN Reading 1, 2; TN Writing 4)

24) Discuss the nature, scope, and importance of branding in product planning. List three different types of brands (Generic, Private, and National). Explain how branding strategies are used to meet sales and company goals, and examine a case study of a successful or failed business attempt at a rebranding effort. Example businesses could include Coke, JCPenney, and Old Spice. (TN Reading 2, 4, 5, 8; TN Writing 2, 4, 9)

25) Identify the functions of labeling. Cite examples of how and why changes have been made to product labels over the course of history. (TN Reading 6, 8, 9; TN Writing 4, 9)

Introduction to Promotion

26) Identify the types of promotion (such as, but not limited to, advertising, direct marketing including social media marketing, sales promotion, personal selling, and public relations) and describe the concept of the promotional mix. Give examples of why all elements of the promotional mix must be coordinated. Identify the major types of advertising media and cite the pros and cons of each. (TN Reading 2, 4; TN Writing 4, 9)

27) Identify the main components of a print advertisement. Design an original ad layout incorporating principles of the components most commonly found in print media. (TN Reading 3, 4, 5, 6, 7; TN Writing 6)

28) Using suitable strategies from the promotional mix, create a product promotional campaign for a local business and or student organization that includes the following steps:
　　　a.　Establish objectives
　　　b.　Identify the target market
　　　c.　Design the theme and promotional message
　　　d.　Select promotional activities and provide timeline
　　　e.　Allocate budget amounts
　　　f.　Measure results
(TN Writing 1, 4, 5, 6)

29) Research the elements of visual merchandising and explain how artistic elements function in a display design. Illustrate how proper and creative use of visual merchandising can drive sales, citing successful examples. (TN Reading 1, 2; TN Writing 2, 4)

Career Development

30) Identify career opportunities in marketing. Using real-time labor market data, research opportunities for job growth in the field. Take a career interest inventory to assess goals and aptitudes, and develop a career plan based on the results. (TN Reading 2, 7; TN Writing 4, 7, 9)

31) Using online employment resources, conduct a job search for a marketing position. Choose two postings and create a Venn diagram illustrating the unique qualifications for each job as well as the common qualifications between them. (TN Reading 2, 7, 9; TN Writing 4, 9)

32) In preparation for a future career in marketing, sales, advertising, or promotion, develop a professional digital portfolio that can be presented to prospective employers. Content artifacts may include cover letter, resume with technical skills attained, certifications, awards, community service projects, membership in professional organizations, follow-up letter, and samples of project work. (TN Writing 4, 6)

33) Participate in a mock interview with local business partners, mentors, and or through participation in a student organization event. Prior to the interview, prepare a paper that includes the following: tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. (TN Reading 2; TN Writing 2, 4, 7, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 or 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 or 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able

> to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.

- TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Marketing & Management II: Advanced Strategies

Primary Career Cluster:	Marketing
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5932
Prerequisite(s):	*Marketing & Management I: Principles* (5931)
Credit:	1
Grade Level:	11 - 12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Marketing courses.
Programs of Study and Sequence:	This is the third course in the *Marketing Management* and *Entrepreneurship* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	030, 035, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-marketing

Course Description

Marketing & Management II: Advanced Strategies is a study of marketing concepts and principles used in management. Students will examine the challenges, responsibilities, and risks managers face in today's workplace. Subject matter includes finance, business ownership, risk management, marketing

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information systems, purchasing, promotion, and human resource skills. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and Tennessee state standards in Economics.*~~

Note for instructors: This course assumes many students are engaged in a work-based learning (WBL) experience such as cooperative education, internships, school-based enterprises, or similar types of worksite experiences with a local partner business. Projects in the course could benefit significantly from the use of resources and data from local businesses. Instructors are encouraged to leverage existing partnerships and to build on advisory committee relationships as they reach out to business owners or managers for authentic scenarios, materials, and other business information from which students could learn.

Program of Study Application

This is the third course in the *Marketing Management* program of study. For more information on the benefits and requirements of implementing this programs in full, please visit the Marketing website at https://tn.gov/education/article/cte-cluster-marketing

Course Standards

Business Ownership

1) Identify the forms of business ownership (such as sole proprietorship, partnership, and corporation). Compare the advantages and disadvantages of each; explore at least four ways to start a business as part of a class discussion. Cite under what circumstances it would be advantageous for a business to form a limited liability company. ~~(TN Reading 1, 2, 4; TN Writing 4, 9)~~

2) Using supporting data obtained from public sources such as the Bureau of Labor Statistics, explain why entrepreneurship is important to the U.S. economy. Compare and contrast the role of the entrepreneur to that of a manager. ~~(TN Reading 1, 2; TN Writing 2, 4, 9)~~

Management Skills

3) Distinguish the differences between horizontally organized and vertically organized companies. Explain how self-management teams function and illustrate how a student organization could be organized around particular processes or specializations with teams providing support. ~~(TN Reading 1, 2, 4, 5; TN Writing 2, 4, 9)~~

4) Discuss why all three functions of management (planning, organizing and controlling) involve decision making and leadership. Describe the steps that should be included in the decision-making process. ~~(TN Reading 2; TN Writing 2, 4, 9)~~

5) Demonstrate effective management skills by role-playing how you would manage a difficult workplace scenario. ~~(TN Reading 9)~~

6) Identify three motivational management techniques that do not include money and describe the characteristics of the situation in which each may be chosen to motivate employees. (TN Reading 1; TN Writing 9)

7) Create a company orientation manual, including sections on, but not limited to, the following.
    a. Hiring
    b. Compensation
    c. Scheduling, including vacation, sick, and paid time off
    d. Social media compliance policy
    e. Handling grievances
    f. Addressing customer feedback
    g. Performance assessments, including performance improvement and rewards
    h. Promotions, transfers, and dismissals
    i. Ethics in the workplace

    (TN Reading 9; TN Writing 2, 4, 7, 9)

Role of Marketing in Business

8) Create a six-month marketing plan aimed at increasing business profitability for the work-based learning partner or another local business. Include the following.
    a. An executive summary with a situational analysis identifying both SWOT (Strengths, Weaknesses, Opportunities, and Threats) and PEST (Political/legal, Economic, Sociocultural, and Technological) factors
    b. Marketing strategies
    c. Cost analysis
    d. Implementation plan
    e. Marketing audit evaluation instrument

    (TN Reading 7, 9; TN Writing 2, 4, 8, 9; TN Math N-Q)

Legal and Ethical Issues

9) Prepare a presentation on a federal statute encompassing consumer or trade laws or business practices (such as the Sherman Antitrust Act, the Robinson-Patman Act, or the Consumer Product Safety Act) that can affect businesses. (TN Reading 2, 4; TN Writing 4, 6, 9)

10) Write a report on ethical dilemmas that could be encountered when conducting business with international partners. Using media reports and/or case studies, cite examples of how U.S. business practices differ from those of other countries. (TN Reading 6; TN Writing 2, 4, 7, 9)

Purchasing

11) Cite the differences between centralized buying and decentralized buying; identify benefits and challenges of each. (TN Reading 4; TN Writing 9)

12) Describe a six-month merchandise plan; identify factors to consider when selecting suppliers and negotiating terms of sale. Based on findings, write recommendations for adding a new product to the company's inventory. (TN Reading 7, 9; TN Writing 1, 4, 7, 9)

Pricing

13) Identify and describe market factors that can affect prices (such as embargos, natural disasters, and overproduction), and cite legal and ethical considerations for price planning, including price fixing and price discrimination, among others. (TN Reading 2, 4)

14) Explain the relationship between pricing and product life cycle. Write an argument supporting either penetration pricing or price skimming as the best pricing strategy to employ when launching a new product. Cite examples from news media or other appropriate texts of how each strategy was used in recent product introductions. (TN Reading 4, 5, 9; TN Writing 1, 4, 7, 9)

15) Explain how a company's profit relates to markup. Using the same product, demonstrate the ability to calculate retail percentage markup and markdown in dollars and percentages. (TN Reading 2; TN Writing 4; TN Math N-Q, A-SSE)

Promotional Concepts

16) Analyze journal articles about effective institutional promotions (e.g. Macy's Thanksgiving Day Parade), identifying benefits achieved. Research a prominent example of an institutional promotion; name the company sponsor, identify any nonprofit benefactors, and construct an essay highlighting factors that contributed to the launch of the promotion as well as to its continued existence. Address how social media tools have been leveraged to support your selected example. (TN Reading 1, 2, 6; TN Writing 2, 4, 8, 9)

17) Design an institutional promotions plan for the WBL partner or another local business. Include all elements of the promotional mix. Identify:
    a. Goals
    b. Target market
    c. Message or theme
    d. Coordination aspects
    e. Action plan/implementation
    f. Evaluation instrument
    (TN Reading 2; TN Writing 4, 9)

18) Describe how a business' image is created and/or enhanced through architectural displays; explain the importance of interior displays to a business' overall image. Create a rubric for evaluating the effectiveness of an architectural/interior display. In groups, divide a list of local businesses to visit. Using the rubric, conduct site surveys to evaluate the displays at a minimum of three businesses per group, and then share findings with the class in a presentation. (TN Reading 2, 7, 9; TN Writing 2, 4, 7)

Marketing Research and Information Management

19) Examine different types of marketing research and define methods for gathering marketing research data; include primary and secondary research methods. (TN Reading 1, 2, 4)

20) Assist in finding a solution to a problem for the WBL partner or another local business using marketing information management. Identify the problem, investigate the problem, and conduct research on potential ways to resolve the problem. Construct and administer a survey of customers or potential customers to determine factors that could be contributing to the problem; include open-ended, forced choice, and rating/ranking survey questions. Present survey findings and recommendations for resolving the problem in a graphic presentation to partner business and peers. (TN Reading 4, 7, 9; TN Writing 1, 4, 6, 7, 9; TN Math N-Q, S-ID, S-IC)

Risk Management

21) Identify the various types of business risk, describing ways in which businesses can manage risk. Provide examples of how risk reduction or prevention can apply to the following areas:
    a. Employee screening and training
    b. Safety conditions and safety instructions
    c. Employee theft
    d. Shoplifting
    e. Reduction in workplace threats
    (TN Reading 2; TN Writing 4)

22) Cite the differences between and features of property and liability insurance. Obtain three quotes for minimum liability insurance coverage for a business in your area, using square footage and inventory on hand as factors on which to base the quote. (TN Reading 4, 5; TN Writing 4, 9)

Business Financing and Financial Statements

23) Describe the differences between equity capital and debt capital and explain the advantages and disadvantages of each. (TN Reading 2, 4)

24) To evaluate the credit worthiness of a business, lenders rely on the six C's (character, capability, capital, collateral, coverage, and conditions). Identify and explain the role each of the six criteria play in a lender's ability to determine overall risk and approve financing. (TN Reading 2, 4, 5; TN Writing 4, 9)

25) Identify the types of financial documents typically included in a business plan. Prepare examples of the following:
    a. Personal financial statement
    b. Estimated startup costs
    c. Projected business income statement for one quarter
    d. Projected balance sheet after one year
    (TN Reading 2, 4; TN Writing 4; TN Math N-Q; TN Economics)

Work-Based Learning Experience

26) Apply principles of marketing and management to a work-based learning opportunity such as job shadowing, internships, or related work-based/work-site experiences.

27) Evaluate and apply principles of ethics as they relate to the work-based experience.

28) Employ safety principles to the work-based experience. (TN Reading 3)

29) Compose and maintain a journal that documents work-site experiences, time management, and ethical workplace behaviors. (TN Writing 4, 5, 10)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 8 and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Statistics and Probability.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.
  - Note: The standards in this course are not meant to teach economics concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with economics educators to design project based activities or collaborate on lesson planning.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advertising and Public Relations

Primary Career Cluster:	Marketing
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5936
Prerequisite(s):	*Marketing & Management I: Principles* (5931) or *Hospitality Marketing* (6169)
Credit:	1
Grade Level:	11 - 12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Marketing courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Marketing Management* and *Hospitality and Tourism Management* programs of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
Teacher Endorsement(s):	052, 152, 153, 158, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-marketing

Course Description

Advertising and Public Relations is an applied knowledge course focusing on the concepts and strategies associated with promoting products, services, ideas, and events. This course addresses skills essential to the creative side of the industry and explores consumer behavior patterns and motivations for buying. Upon completion of this course, proficient students will be able to demonstrate understanding in fundamental advertising and public relations concepts by creating an electronic portfolio of representative course projects. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, as well as Tennessee Sociology and Psychology standards.*

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Program of Study Application

This is the fourth and final course in the *Marketing Management* and *Hospitality and Tourism Management* programs of study. For more information on the benefits and requirements of implementing these programs in full, please see the following websites:

- Marketing: https://tn.gov/education/article/cte-cluster-marketing
- Hospitality & Tourism: https://tn.gov/education/article/cte-cluster-hospitality-tourism

Course Standards

Marketing Mix

1) Articulate important historical events and milestones (such as compulsory education, industrial revolution, and transportation improvements) impacting evolution of current advertising industry. Compare and contrast characteristics of the current advertising and public relations industry with those found the past. (TN Reading 9)

2) Research careers within the advertising and public relations industry, and document educational requirements as well as state and national guidelines governing practicing professionals (such as licensing, certifications, training, compliance). Identify potential training programs, schools, and examinations appropriate to obtain required credentials for a specific occupation. (TN Writing 2, 7, 8, 9)

3) Analyze how the elements of the marketing mix (e.g., product, place, price, and promotion) create an image or position for a product or company. Investigate elements of the marketing mix using a specific product example and explain in an informative text how marketers make decisions about these elements based on the people they want to attract as customers. (TN Reading 2, 4, 7; TN Writing 2, 4, 7, 9)

Segmentation and Target Marketing

4) Identify and describe characteristics of classifications of market segmentation (such as demographics, psychographics, and geographics); analyze multiple case studies to draw conclusions and write a narrative explaining the benefits of segmentation for consumer messaging. (TN Reading 2, 4, 6, 7, 8; TN Writing 2, 7, 9; TN Sociology; TN Psychology)

5) Research how targeting specific economic, social, or cultural groups can lead to a competitive advantage (e.g. calling attention to a brand's social awareness efforts may increase sales of a specific product for those consumers who enjoy gourmet ice cream and who also have a preference for environmentally conscious products). Identify product marketing examples that narrowly segment their target audience, citing specific textual evidence from investigation to analyze producers' purpose in developing specific marketing campaigns. (TN Reading 1, 6; TN Sociology; TN Psychology)

Concepts of Promotional Mix

6) Define and differentiate between the components of the promotional mix (advertising, sales promotion, personal selling, direct marketing, and public relations) citing examples of specific products or services found in local community. (TN Reading 1, 9)

7) Define characteristics and implications for each of the four steps of the AIDA (Attention, Interest, Desire, Action) formula. In groups, select a product and create example consumer engagement strategies that apply to each step. (TN Reading 3, 4; TN Writing 4)

Advertising

8) Identify and distinguish between types of advertising media by creating a graphic organizer to compare and contrast the advantages and disadvantages of each type. Develop and defend claim(s) about which types are best suited for certain products, services, institutions, or events, citing authentic examples. For example, pharmaceuticals often utilize print media due to the lengthy disclaimer text that must accompany prescription drug advertising. (TN Reading 4, 7, 9; TN Writing 4)

9) Distinguish between promotional and institutional advertising by creating examples of each for a local company or nonprofit organization. (TN Writing 4)

10) Write an informative narrative summarizing how media costs are determined, citing specific textual evidence and using domain-specific language. Include factors that affect media rates and methods to compare rates. (TN Reading 2, 4, 9; TN Writing 2)

11) Identify the elements of a print-based advertisement (such as headline, illustration, copy, signature, or logo) and analyze their relationship to the principles of effective advertising design (e.g., balance, color, proportion). (TN Reading 4, 5)

12) Demonstrate an understanding of effective advertising copywriting and design by creating an ad layout. Write peer reviews critiquing the design, key message, and probable effect on target audience. Develop and strengthen writing by revising and editing layout based on peer feedback. (TN Reading 8; TN Writing 2, 4, 5)

Sales Promotion

13) Compare various forms of sales promotion (such as coupons, contests, fashion shows, product samples, rebates, and incentives) and determine methods for measuring results of each. Craft a claim about the return on investment from a particular promotion, providing specific examples of company benefit from perceived consumer value. (TN Reading 1, 9)

Social Media and Digital Marketing

14) Explain the value of social media marketing for increasing market reach and customer interaction. Compare and contrast features and benefits of major social media applications (such as social networks, video sharing, and interaction tools as well as mobile marketing, blogs, and other forms of "push" media). Synthesize characteristics and components of each

application by creating a decision tree for selecting tools and strategies that will result in effective brand promotion and customer interaction based on product and market characteristics. (TN Reading 4, 7; TN Writing 4)

15) Create a series of posts to promote a selected product or organization via social media using writing strategies and styles appropriate for the selected tool and immediacy of customer responses. (TN Writing 4, 6)

16) Identify and describe characteristics of essential features of a product website, including visual components, navigation features, and optimization for search engines. Create a rubric to evaluate the effectiveness of a website's design and interactive features. (TN Reading 6; TN Writing 4)

17) Interview individuals who have recently completed an online purchase by preparing interview questions that critique the experience, including: documenting overall impressions of the product selection, purchasing experience, and the features that facilitated or hindered the website usage. Deliver a presentation synthesizing customer feedback based on the interviews. (TN Writing 4, 7)

18) Work in a team with identified roles and responsibilities to develop a website for product or brand promotion. Create a flowchart of website elements, consumer interaction points, and decision trees to identify steps in the product review, selection, and purchasing process. Execute the plan by designing, maintaining, and updating the website based on consumer feedback. (TN Reading 7; TN Writing 5, 6)

Utilizing Marketing Research and Data Management

19) Explain the need for market research data, including both primary and secondary data. Identify and differentiate types of data available through electronic tracking methods (e.g. warranty registrations, sales records, online surveys, website cookies, and loyalty cards). (TN Reading 2, 4, 5, 7; TN Writing 2, 8, 9)

20) Design a survey with a focus on product or service improvement; collect survey data, and interpret, analyze, and report key survey findings through charts or graphs. Write an argumentative essay that outlines recommendations for specific improvements, citing evidence found in survey findings. (TN Reading 7; TN Writing 2, 4, 7; TN Math S IC, S ID)

Public Relations

21) Through the analysis of case studies, discuss the role of public relations in the promotional mix and identify various types of public relations strategies. Differentiate between public relations activities that are controllable and those that are not (e.g., BP's news coverage after the gulf oil spill versus paid advertisements showing environmentally conscious behavior); include public relations vehicles used internally by companies in the analysis. (TN Reading 5, 9)

22) Through the analysis of case studies (e.g., Tylenol product recalls, Carnival Triumph's electronic malfunction), examine the role of public relations in crisis management. Develop an explanatory narrative and accompanying timeline describing public relations strategies and tactics that were put in place to address negative publicity during a newsworthy crisis. (TN Reading 2, 6, 8; TN Writing 2, 9)

23) Develop a press kit for a product or student organization that includes a press release, fact sheet, and at least three strategies for marketing the product or organization to a target audience. Recommend one of the three options presented and substantiate the claim with evidence as to why that strategy would be ideal given the specified audience and context. (TN Writing 1, 4)

Promotional Campaigns

24) Using suitable strategies from the promotional mix, create a product promotional campaign which includes the following steps:
   a. Establish Objectives
   b. Identify the Target Market
   c. Design Theme and Promotional Message
   d. Choose Promotional Activities
   e. Select Media
   f. Allocate Budget Amounts
   g. Measure Results
   (TN Reading 3, 4, 7; TN Writing 4, 5, 6, 7, 9)

Ethics, Government Regulations, and Global Implications of Marketing

25) Summarize legal opinions and/or applicable legislation (such as "bait and switch" and use of nutritional labels) and industry self-regulation (including ethical considerations and social responsibility) applicable to the advertising and public relations industry. (TN Reading 2)

26) Explore the implications of marketing to a global consumer; use case studies to evaluate how the customs and traditions of other countries affect American companies' advertising messages in the global marketplace. Write recommendations for marketing a product in a selected country based on customs and traditions. (TN Reading 1, 2, 8; TN Writing 1, 4, 7; TN Sociology; TN Psychology)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.

- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Interpreting Functions, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- ~~TN Sociology: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Sociology 9-12.~~
  - ~~Note: The standards in this course are not meant to teach sociology concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with sociology educators to design project-based activities or collaborate on lesson planning.~~
- ~~TN Psychology: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Psychology 9-12.~~
  - ~~Note: The standards in this course are not meant to teach psychology concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with psychology educators to design project-based activities or collaborate on lesson planning.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

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Entrepreneurship

Primary Career Cluster:	Marketing
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5934
Prerequisite(s):	*Marketing & Management I: Principles* (5931)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	Completion of one credit of *Entrepreneurship* satisfies the *Economics* requirement for graduation. This course satisfies one of three credits required for an elective focus when taken in conjunction with other Marketing courses.
Programs of Study and Sequence:	This is the third course in the *Entrepreneurship* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/article/cte-cluster-marketing.
Available Industry Certifications	None
Dual Credit or Dual Enrollment	There are currently dual credit opportunities available for this course at specific community colleges. Contact a local postsecondary institution(s) for more information.
Teacher Endorsements	030, 035, 039, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-marketing

Course Description

Entrepreneurship is an applied knowledge course that begins with the discovery process of generating new business ideas. Students research local, national, and international social and economic trends and analyze the feasibility of their own proposed businesses, both from a market demand and revenue-producing standpoint. Based on their entrepreneurial endeavors, students will prepare, write, and revise

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a business plan. In preparation for the business plan, students will conduct market research, study ownership structures, evaluate risks, examine startup costs, determine essential vendors, and identify sources of capital and financing options. Students will also draft, refine, and rehearse entrepreneurship pitches developed from their business plans to present during course intervals and to give final presentations at the conclusion of the course. Upon conclusion of this course, proficient students will be able to articulate, and defend, elements of a full business plan for a new business. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards for Mathematics, and Tennessee Economics standards.*~~

Program of Study Application

This is the third course in the *Entrepreneurship* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Marketing website at https://tn.gov/education/article/cte-cluster-marketing.

Course Standards

This course is designed to provide a comprehensive outline and development of the necessary segments of a business plan for a startup venture. Standard 5 can be used to drive brainstorming and critical thinking to identify a potential business startup idea that students will continue to develop throughout the course. Students can approach this course individually or in teams, depending on background, knowledge and skills, and quality of business idea(s). Standards 6-17 should focus on the selected business startup idea and should be approached as parts of a larger whole rather than separate projects.

The Role of Entrepreneurs

1) Define the term *entrepreneur* and describe the key components of the entrepreneurial startup process (the entrepreneur, the environment, the opportunity, startup resources, and the new venture organization). Prepare an informative text to explain each component and identify the risks and rewards encountered in an entrepreneurial endeavor, highlighting the advantages and disadvantages of owning a business versus working for someone else. ~~(TN Reading 4; TN Writing 2; TN Economics 1)~~

2) Evaluate the role of entrepreneurship in the U.S. economy, and describe the expansion and growth of entrepreneurship in the current decade. Draw evidence from informational texts to examine how business cycles, economic indicators (i.e., interest rates, inflation, and unemployment) and free enterprise system characteristics such as profit motive, private property, and competition impact entrepreneurial decision making. ~~(TN Reading 1, 2, 4, 5; TN Writing 7, 8, 9; TN Economics 1, 2)~~

3) Research the backgrounds and business ventures of successful entrepreneurs to draw conclusions about the personal traits, experiences, and behaviors associated with entrepreneurship, including professional values and specific skills. Compare findings to personal strengths to assess potential for becoming a successful entrepreneur by completing an entrepreneurial characteristics assessment and self-evaluation. Using the results of the self-assessment, identify areas of strengths and weaknesses and choose characteristics to develop. Prepare a written plan to further educational attainment, develop new skills, or seek work experience to develop identified skills. ~~(TN Reading 1, 3, 9; TN Writing 2, 7, 8, 9)~~

4) Building on the research in Standard 3, select a well-known entrepreneur and summarize his/her strongest entrepreneurial characteristics, major business venture, and the problem the entrepreneurship sought to address with his/her venture. Analyze and cite any unique contributions to the U.S. economy or culture associated with the entrepreneur's endeavors. Make connections between information gathered during research and personal reflection from Standard 3. (TN Reading 1, 2, 6; TN Writing 7, 9)

Entrepreneurship Potential

5) Review news media and labor projections to identify current and projected trends in social and/or economic development, including but not limited to: web-based businesses, customer privacy, green businesses, social entrepreneurship, and more. In teams or individually, compile a list of potential ideas that have commercial potential not currently being met by existing businesses. (TN Reading 1, 8; TN Writing 7; TN Economics 1, 2)

6) Analyze domestic and international opportunities for entrepreneurial ventures. Use the International Trade Statistics Yearbook of the United States, or other reliable sources, to research and locate the best global markets for a given product. Identify financial export assistance programs that U.S. government agencies and investment corporations offer; prepare a mock application for assistance following procedures and requirements. (TN Reading 1, 4; TN Writing 4, 9)

Social and Ethical Responsibility

7) Examine different examples of business codes of ethics. Synthesize principles from the research, highlighting ethical problems typical for entrepreneurs such as conflicts of interests, bribes, and patent/copyright infringement. Create a written code of ethics for the proposed business. (TN Reading 2, 4, 6, 9; TN Writing 2, 4)

8) Explore the growth of social responsibility in capitalism by reviewing news reports and journal articles about social entrepreneurship ventures. Create an informative text to define the term "conscious capitalism" and summarize how it is a growing business model for entrepreneurship. (TN Reading 2; TN Writing 4, 9)

Business Plan Development

9) Write, review, and revise a business plan for a potential entrepreneurial endeavor. The plan should include: an executive summary, company description, vision and mission statements, industry overview, market analysis, marketing plan, operations plan, and financial plan. Use resources such as the Small Business Administration (SBA), Service Corps of Retired Executives (SCORE), chambers of commerce, business incubators, and glencoe.com to locate and critically evaluate business plan templates. (TN Reading 1, 3; TN Writing 2, 4, 5, 6, 9; TN Economics 4)

10) Construct a market research project for the identified endeavor. Develop a research question, then determine, develop and conduct the appropriate research (primary research, secondary research, scientific method) to achieve the desired analysis. Summarize results of

the research in recommendations in the business plan overview and market analysis. (TN Reading 1, 3, 9; TN Writing 4, 6, 7, 8; TN Math S-ID)

11) Develop a customer profile with a detailed description of the potential target market for the proposed business based on demographic, geographic, psychographic, and behavioral information. Assess the viability of the profile for the proposed business by determining number of customers, reachability, and desire for product. Include these findings in the business plan's overview and market analysis section. (TN Reading 1, 4; TN Writing 4, 7, 9)

Marketing

12) Prepare a brief outline of the proposed business' marketing plan including pricing, promotion, and service/product planning in the development of customer relationships. Explain multiple pricing, promotions, and product selection strategies for the proposed business. Summarize how one or all of these strategies can directly impact a customer's experience. (TN Reading 1; TN Writing 2, 4; TN Math S-ID)

13) Enhance the marketing plan with a proposal for attracting early adopters to the proposed product or service. Include ideas for preopening with the following objectives: establishing image, advertising methods, customer contact and interaction, generating appeal, and follow-up. Make a claim about the correct proportions of the marketing mix, supporting claim with data and evidence and addressing counterclaim(s) about alternative methods. (TN Reading 1, 3; TN Writing 1, 4, 9)

Operations

14) Compare and contrast the different ownership options for the proposed business. Identify the legal regulations required for the type of ownership selected. Prepare a sample partnership agreement or Doing Business As (DBA) document that outlines the division of assets, rights, and responsibilities of each owner. (TN Reading 3, 4; TN Writing 4, 8)

15) Investigate channel management and distribution methods for the proposed product or service. Research possible manufacturers; study distribution considerations of the product or service, (including transportation, storage, handling, and packaging for products or staffing, training, and evaluation for services); cite justification for the channel management decisions, such as cost-saving benefits to the business' bottom line. Prepare a sample service contract with a potential vendor for first year of business. (TN Reading 1, 3, 4; TN Writing 4, 7; TN Math N-Q)

Financials

16) Examine startup costs, operating costs, overhead, and personal expenses by researching and developing a financial statement based on models obtained from public records or business websites. Contact local lending institutions regarding requirements for business loans and needed documentation such as personal income statement, tax records, credit reports, loan history, and personal investment. Prepare financial statements and charts and graphs for the proposed business plan, including but not limited to:

a. Estimated start-up costs
b. Projected Income Statement
c. Projected Balance Sheet
d. Cash Flow

Create a pro forma projection of a. – d. above. Establish length of view, i.e. first year, 3-year, 5-year timelines. Generate a breakeven analysis. (TN Reading 1, 4, 7, 9; TN Writing 4, 9; TN Math N-Q)

17) Investigate potential sources of startup capital needed to secure financing (e.g. equity financing, personal savings, angel investors, partnerships, venture capitalists, and debt financing) and list advantages and disadvantages of each. Visit or research local banks, entrepreneurship centers, or incubators to determine the most common reasons investors decline to invest in order to ensure business plan addresses typical concerns. (TN Writing 4, 7)

18) Prepare a "pitch" to explain the business to a potential investor, including breakdown of necessary financing and requested terms. Justify requested funding, using financial figures with appropriate data and evidence from coursework. Evaluate potential financing offers that may be different from requested terms. Based on the evaluation, choose to either accept or not accept the proposal. For example, based on startup costs needed and future valuation, pitch a request for $100,000 to a potential investor in return for a 25% stake in the proposed business. Then evaluate whether or not to accept a counteroffer of a proposed $100,000 for a 50% stake. (TN Reading 1, 4; TN Writing 2, 4, 5, 6, 8; TN Math N-Q)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.
  - Note: The standards in this course are not meant to teach economics concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with economics educators to design project based activities or collaborate on lesson planning.
- TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number, Quantity, Functions.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to

~~collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Retail Operations

Primary Career Cluster:	Marketing
Consultant:	Anna Ogburn, (615) 253-7442, Anna.Ogburn@tn.gov
Course Code(s):	5938
Prerequisite(s):	*Marketing & Management I: Principles* (5934)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	Completion of one credit of *Retailing Operations* satisfies the *Economics* requirement for graduation. This course satisfies one of three credits required for an elective focus when taken in conjunction with other Marketing courses.
Programs of Study and Sequence:	This is the fourth and final course in the *Marketing Management* program of study.
Aligned Student Organization(s):	DECA: http://www.decatn.org FBLA: http://www.fblatn.org Steven Mitchell, (615) 532-2829, Steven.Mitchell@tn.gov
Coordinating Work-Based Learning	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Industry Certifications:	None
Dual Credit or Dual Enrollment:	There are currently dual credit opportunities available for this course at specific community colleges. Reach out to your local postsecondary institution(s) for more information.
Teacher Endorsements:	030, 035, 052, 054, 152, 153, 158, 202, 204, 311, 430, 435, 436, 471, 472, 474, 475, 476
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-marketing

Course Description

Retail Operations is designed to challenge students with the real world of supply chain management and merchandising services. The standards in this course are designed to prepare students with skills and knowledge related to buying, selling, human resource management, business operations, product management, promotion, and customer service. Decision-making skills, financial management,

Approved April 10, 2015; Amended April 15, 2016

customer relations, ethics and legal issues are also addressed. Upon completion of this applied knowledge course, proficient students will have skills essential for entering careers as retail associates at entry and mid-level management as well as be prepared to enter postsecondary programs in business and marketing. The content lends itself to both work-based learning and school-based enterprises opportunities.

Program of Study Application

This is one of three potential capstone courses in the *Marketing Management* program of study. Marketing programs are encouraged to offer one or more capstones based on teacher background, community need, and student interest. For more information on the benefits and requirements of implementing this program in full, please visit the Marketing career cluster website at https://tn.gov/education/article/cte-cluster-marketing.

Course Standards

Introduction to Retailing

1) Investigate the origins of retailing in the United States. Research emerging trends in retailing, including the expansion of e-tailing, the growth of mobile marketing, the inclusion of social media, and the embrace of green marketing, among others. Create a timeline citing specific textual evidence outlining the historical evolution of retailing in the U.S. including significant changes in the last decade. Make a prediction about the impact of current technological and cultural shifts on the future of retailing. (TN Reading 1, 2, 7; TN Writing 6, 8, 9)

2) Identify local retailers and justify their categorization as a merchandise and/or service retailer. Defend the categorization by identifying the definitions, differences and similarities of each. Describe the services that are performed by each type of retailer and propose different methods for maintaining and building the clientele of each. (TN Reading 3, 4, 9; TN Writing 2, 4, 8)

3) Discuss the importance of customer experience in a retail environment by evaluating characteristics about the experience (online/in-store) that makes a customer loyal to that retailer. Document a list of reasons a customer may enjoy shopping in a specific environment, including specific characteristics that differentiate the experience from other retailers. (TN Reading 3, 4, 5, 8; TN Writing 4, 7)

Retail Careers

4) Using print, online, and/or personal interview sources, develop a career profile for at least three occupations (managerial level or above) found in national or international retail businesses. Capture, at minimum, the following:
   a. Job description
   b. Essential knowledge and skills needed for the career
   c. Program or path of study to reach occupational goals, high school through postsecondary (colleges of applied technology, community colleges, and four-year universities)
   d. Licensure and credentialing requirements
   e. Non-educational job requirements such as physical fitness tests, minimum age, and other
   f. Benefits such a travel, free samples, etc.

g. Salaries, bonuses, payment methods (including salary and commissions)
h. Employment outlook
(TN Reading 1, 7; TN Writing 4, 9)

Economics of Retailing

5) Research and explain the economic function of retailing in the local, state, national, and global economy. Explore the impact of government regulations on the retail industry, citing specific examples from legislation such as the Food, Drug, and Cosmetic Act or the Consumer Product Safety Act. Develop a claim about a particular trade practice governed by law and draw conclusions about the impact of that practice without laws to govern retailing. For example, explore a trade practice deemed unfair and investigate the impact of the practice on retail operations and the economy prior to legislation banning the practice. (TN Reading 1, 2, 8, 9; TN Writing 4, 7, 8; TN Economics 4)

6) Investigate and chart the impact of business cycles on the retail environment using past and present economic data, case studies and information from multiple professional journals and/or news articles. Predict the impact that forecasted economic trends will have on the retail environment and retail opportunities in shifting economies in both short term (1 year or less) and long term (5 years) analysis. (TN Reading 2, 4, 9; TN Writing 4, 9; TN Economics 2)

7) Summarize how businesses make and review pricing decisions based on four key market factors: cost and expenses, supply and demand, consumer perception, and competition. Analyze each factor and determine and describe how each relates to pricing goals of earning a profit, gaining market share, and being competitive. (TN Reading 2, 4, 9; TN Writing 2, 4; TN Economics 1)

Marketing Research

8) Explain the need for both primary and secondary market research data in the retail industry. Identify and evaluate types of data available through electronic tracking methods (e.g. warranty registrations, sales records, online surveys, website cookies, and loyalty cards) and illustrate how this information could be used by the retailer by constructing a pivot chart to draw conclusions about customers from data gathered from one of the above tracking methods. (TN Reading 1, 4; TN Writing 6, 8, 9)

9) Address a chosen marketing question, including outlining methodology used to gather data by developing a written or electronic survey targeting a local retailer or school-based enterprise. Survey may address topics such as: determining possible new products/services, measuring brand awareness and brand loyalty, determining consumer perception, etc. Analyze data and present findings and recommendations to the class and/or a local business owner using professional presentation techniques. (TN Reading 3, 4; TN Writing 4, 6, 7, 9)

Security and Risk Management in Retail

10) Evaluate the types of risk present in the retail environment including security concerns and construct a plan for a local retailer or school-based enterprise to manage these risks. Analyze the various methods of controlling losses resulting from shrinkage, vendor collusion, and theft. Include cost in the analysis. (TN Writing 4, 9)

Inventory, Buying, and Pricing

11) Research the concept of inventory planning, stock turnover rates, and the buying process. Develop a six-month merchandise plan and open-to-buy for a retail department or product category. Prepare a scenario summary accounting for current inventories, current purchases, current expenses, and best and worst case scenarios based on six-month merchandise plan and sales forecast analysis. (TN Reading 1, 3, 4; TN Writing 4, 6; TN Math N-Q)

12) Explain standard procedure for ordering and invoicing purchases used in the retail industry. Evaluate and compare the basic types of inventory and Point of Sale (POS) systems used in retail and make a recommendation citing research for best suited tracking methods and vendors for a small retailer or school-based enterprise. (TN Reading 3, 4, 8; TN Writing 4, 9)

13) Calculate retail prices for specific products using cost-plus, mark-up, and mark-down formulas include calculation for overall margin mix. Summarize prices through a detailed explanation of the concept of cost and profits used to establish budgets and prices. (TN Reading 1, 3, 4; TN Writing 4, 9; TN Math N-Q, A-CED)

Location, Layout, and Visual Merchandising

14) Investigate the factors businesses use when selecting a physical location for a retail store. Evaluate the local community and make a claim about an ideal retail location, citing data and evidence from research. Include an analysis of traffic (foot and vehicle) and target markets in the area. (TN Reading 1, 2; TN Writing 1, 7)

15) Compare and contrast the types of retail store layouts and prepare recommendations for when each should be used. Research the use of plan-o-grams to maximize floor space and select an appropriate product and create a plan-o-gram for a retail store or department. Present plan with explanation for peer review to class members. (TN Reading 1; TN Writing 6)

16) Investigate the aspects of visual merchandising and relate them to developing a store/brand image. Conduct a study of a local retail store's use of location, layout, and visual merchandising and evaluate the effectiveness of their plan. Make recommendations for improving their use of these elements to attract a specific target market. (TN Reading 3, 4, 6; TN Writing 4, 7, 8, 9)

Retail Product, Promotion, and Selling

17) Construct a marketing plan for a virtual business, school store venue, or career and technical student organization (CTSO) project. Include basic elements such as: a mission statement, SWOT analysis, marketing strategies, product selection, and evaluation process. Describe the marketing mix variables and how they relate to the implementation of the marketing plan. (TN Reading 1, 2; TN Writing 2, 4)

18) Research the importance of personal selling in the retail environment and explain the impact the sales person has on image, customer service, and profit. Distinguish between the types of selling (inside, outside) to determine how various selling techniques can influence customer-buying decisions. Create a training plan for new sales employees. Incorporate relationship marketing

methods and the importance of conveying product value to the customer in the training. (TN Reading 2, 4; TN Writing 4)

19) Evaluate a retail store's promotional campaign for increases in sales and customer traffic by developing and utilizing a social media campaign. Research current events and case studies illustrating the use of social media. Create an original social media campaign based on a local retailer or school based enterprise. (TN Reading 1, 2, 8; TN Writing 4, 6, 7)

20) Research three retailers who are promoting green products or green promotional efforts. Analyze their claims of producing environmentally friendly products or services and develop a presentation supporting or opposing their "green" marketing position. (TN Reading 2, 4, 6, 8; TN Writing 8, 9)

Human Resource Management

21) Analyze the staffing needs for a medium size retail store considering departments, security, and hours of operation. Create a staffing schedule for one month to maximize coverage and minimize payroll cost. Calculate daily payroll cost and revise presentation based on findings. (TN Reading 1; TN Writing 4, 5)

22) Construct the agenda for a sales staff meeting. Relate the elements of a positive working environment and motivational techniques to minimize employee turnover. Develop written human relations policies and guidelines to generate a positive retail work environment. Role-play workplace situations surrounding the promotion of a positive work environment for presentation in the meeting. (TN Reading 2, 3; TN Writing 4, 9)

23) Explore legal issues relating to staffing and the impact they have on the business, employees, and customers (minimum wage, medical insurance requirements, equal opportunity, harassment, etc.). Research national and international labor issues (i.e. the demand for a raise of the minimum wage) relating to the retail industry. Write an informative essay exposing the issue, citing evidence from research. (TN Reading 2, 4, 9; TN Writing 2, 4, 9)

Ethics in Retailing

24) Evaluate principles of ethics in retailing. Construct an essay describing an ethical challenge retailers face, such as theft of customer personal information, pressure sales tactics, psychological pricing, justifying charging higher prices for sustainable products, or undocumented product claims. Construct a project management toolkit for managers with steps to take and resources available as a guide to making decisions involving ethical issues. (TN Reading 2; TN Writing 4)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11 – 12 Students (pages 64-66).~~
  - o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Economics: Tennessee Department of Education Curriculum Standards, Secondary 9-12 Social Studies, Economics 9-12.~~
  - o ~~Note: The standards in this course are not meant to teach economics concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with economics educators to design project based activities or collaborate on lesson planning.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number, Quantity, Functions, Algebra.~~
  - o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Engineering and Technology

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	5924
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the first course in the *Engineering* and *Technology* programs of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students may be qualified to sit for the American Design Drafting Association (ADDA) Certification Exam upon completion of the *Engineering Design* program of study.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Approved April 10, 2015; Amended April 15, 2016

Course Description

Principles of Engineering and Technology is a foundational course in the STEM cluster for students interested in learning more about careers in engineering and technology. This course covers basic skills required for engineering and technology fields of study. Upon completion of this course, proficient students are able to identify and explain the steps in the engineering design process. They can evaluate an existing engineering design, use fundamental sketching and engineering drawing techniques, complete simple design projects using the engineering design process, and effectively communicate design solutions to others. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the first course in both the *Engineering* and the *Technology* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Introduction to Engineering & Technology

3) Research the definition of each term within STEM: Science, Technology, Engineering, and Mathematics. Use these definitions and additional print and electronic resources (such as textbooks, National Science Teacher Association's STEM Classroom newsletters, or the websites of organizations like *STEM Connector*) to develop a written argument describing why science, mathematics, and technology are different than engineering, yet each influences engineering. Incorporate proper citation conventions used in STEM fields (MLA, APA, or other) to cite sources of information retrieved. ~~(TN Reading 1, 5; TN Writing 2, 9)~~

4) In teams, produce a timeline or infographic illustrating important events in history, in a given time period, that specifically involve engineering. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. ~~(TN Reading 1, 8; TN Writing 2, 8)~~

5) As a team, develop a written explanation of how society benefits from the contributions of engineers in at least three different engineering disciplines. Provide detailed descriptions of each discipline and describe the specific benefits derived from each. For example, describe how

civil engineers improve the efficiency and safety of transportation networks through the construction of bridges, highways, and other public infrastructures. Documents should contain links to relevant websites to illustrate the ideas presented. ~~(TN Reading 1, 2; TN Writing 2, 6, 7, 8)~~

Engineering Design Process

6) There are different versions of the engineering design process. For example, examine the following framework endorsed by the International Technology and Engineering Educators Association (ITEEA):
    a. Identify the problem
    b. Identify criteria and specify constraints
    c. Brainstorm possible solutions
    d. Research and generate ideas
    e. Explore alternative solutions
    f. Select an approach
    g. Write a design proposal
    h. Develop a model or prototype
    i. Test and evaluate
    j. Refine and improve
    k. Create or make a product
    l. Communicate results

    Citing this framework or other variations as approved by the instructor, compare and contrast what is involved at each step of the engineering design process. Explain why it is an iterative process and always involves refinement. ~~(TN Reading 3, 4, 5; TN Writing 2, 4, 9)~~

7) In teams, evaluate an existing large-scale engineering design using the engineering design process. Produce a report on the chosen design, and assume the role of the engineering design team that produced the design. Document constraints that may have been faced by the design team, criteria for measuring the effectiveness of the design, and progress through each step of the engineering design process. Create and deliver a presentation appropriate for a career and technical student organization (CTSO) event. ~~(TN Reading 3, 4, 5, 7; TN Writing 2, 4, 9)~~

8) Complete a simple design activity and apply the engineering design process to produce a model that an engineer would test. Define criteria for determining an effective design, describe constraints on the design, and document each step in an engineering notebook. At the completion of the design process, present the model to the class and critique the design of other classmates. ~~(TN Reading 3, 4, 5, 7, 9; TN Writing 4, 7)~~

Fundamental Sketching and Engineering Drawing

9) Define the differences in technique among freehand sketching, manual drafting, and computer-aided drafting (CAD), and describe the skills required for each. Create a two-dimensional orthographic (multiview) drawing incorporating labels, notes, and dimensions, using sketching/geometric construction techniques. Apply basic dimensioning rules and properly use different types of lines (e.g., object, hidden, center). The orthographic projections should include principle views of a simple object from top, front, and right sides. ~~(TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)~~

10) Building on the knowledge of a two-dimensional drawing, create simple isometric (3-D pictorial) drawings, properly using lines (e.g., object, hidden, center), labels, and dimensioning techniques. ~~(TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)~~

11) Use CAD software to create simple two-dimensional and three-dimensional drawings, accurately incorporating labels, notes, dimensioning, and line types to design drawings. Perform basic operations such as creating, saving files, opening files, storing files, and printing. ~~(TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)~~

Introduction to Measurement

12) Use physical measurement devices typically employed in engineering to collect and build a dataset. For example, calipers may be used to measure the width of pens in the classroom, generating a dataset. Tools should include, but are not limited to, fractional rule, metric rule, dial caliper, and micrometer. ~~(TN Reading 1, 3, 7; TN Writing 4; TN Math N-Q)~~

Class Project

13) As a class, identify a problem in the school or community that can be solved by an engineer. Follow the design process to solve the problem. The class will collaboratively develop a paper following the format of a typical technical report (see components of the report below). Upon completion of the report, create and deliver a presentation for a CTSO event using appropriate citation conventions learned in the course. Refine the report as would a team of engineers by incorporating feedback from the presentation.

The technical report should include, but is not limited to:
   a) Background
   b) Problem definition
   c) Design constraints
   d) Methodology
   e) Data analysis (e.g., charts, graphs, calculations)
   f) Results/Problem solution (including engineering drawings)
   g) Conclusions and recommendations for future research
   ~~(TN Reading 1, 3, 4, 5, 7, 9; TN Writing 2, 5, 6, 7, 8, 9, 10)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~

- - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 1, 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. While not aligned to one specific conceptual category, students who are engaging in the activities outlined above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Engineering Design I

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6139
Prerequisite(s):	*Principles of Engineering & Technology* (5924), *Algebra I* (0842, 3102), and *Physical Science* (3202) or *Biology* (3210)
Co-requisite:	*Geometry* (0843, 3108)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the second course in the *Engineering* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students may be qualified to sit for the American Design Drafting Association (ADDA) Certification Exam upon completion of the *Engineering Design* program of study.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 413, 414, 415, 416, 417, 418, 230, 232, 233, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Approved April 10, 2015; Amended April 15, 2016

Course Description

Engineering Design I is a fundamental course in the STEM cluster for students interested in developing their skills in preparation for careers in engineering and technology. The course covers essential knowledge, skills, and concepts required for postsecondary engineering and technology fields of study. Upon completion of this course, proficient students are able to describe various engineering disciplines, as well as admissions requirements for postsecondary engineering and engineering technology programs in Tennessee. They will also be able to identify simple and complex machines; calculate various ratios related to mechanisms; explain fundamental concepts related to energy; understand Ohm's Law; follow the steps in the engineering design process to complete a team project; and effectively communicate design solutions to others. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Students are expected to use engineering notebooks to document procedures, design ideas, and other notes for all projects throughout the course.

Program of Study Application

This is the second course in the *Engineering* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Career Exploration

3) In teams, use an online editing tool to develop an informational paper or infographic illustrating various engineering disciplines (e.g., civil, mechanical, electrical, chemical, biomedical, computer, agricultural, industrial, and aerospace). The descriptions should contain definitions, job roles, professional societies, and applicable licenses and/or certifications associated with each discipline. Use a variety of sources to gather data, cite each source, and briefly describe why the chosen source is reliable. ~~(TN Reading 1, 7, 8; TN Writing 2, 6, 8)~~

4) Research the postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer engineering or engineering technology programs. Write an informative paper or develop an infographic identifying

admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare individuals to be successful in a postsecondary engineering or engineering technology program. (TN Reading 1, 5; TN Writing 4)

Engineering Design Process

5) Compare and contrast the following engineering design process with the following eight common practices of science and engineering (Achieve, 2013). Based on observations, write a brief paper explaining how the engineering design process and the practices overlap. Present findings to the class and refine the paper based on feedback. (TN Reading 2, 5; TN Writing 2, 5)

Engineering Design Process	Science and Engineering Practices
a) Identify the problem	a) Asking questions (for science) and defining problems (for engineering)
b) Identify criteria and specify constraints	b) Developing and using models
c) Brainstorm possible solutions	c) Planning and carrying out investigations
d) Research and generate ideas	d) Analyzing and interpreting data
e) Explore alternative solutions	e) Using mathematics and computational thinking
f) Select an approach	f) Constructing explanations (for science) and designing solutions (for engineering)
g) Write a design proposal	g) Engaging in argument from evidence
h) Develop a model or prototype	h) Obtaining, evaluating, and communicating information
i) Test and evaluate	
j) Refine and improve	
k) Create or make a product	
l) Communicate results	

Problem-Solving Format

6) Apply a problem-solving format for assigned engineering problems. The format should include the *problem statement* with illustration (e.g., free body diagram), what is *given,* what the student is asked to *find,* a list of assumptions, a list of equations to be used to solve the problem, and the step-by-step solution. (TN Reading 3; TN Writing 4)

Engineering Drawing**

7) Define the differences in technique among freehand sketching, manual drafting, and computer-aided drafting (CAD), and describe the skills required for each. Create a two-dimensional orthographic (multiview) drawing incorporating labels, notes, and dimensions, using sketching/geometric construction techniques. Apply basic dimensioning rules and properly use different types of lines (e.g., object, hidden, center). The orthographic projections should include principle views of a simple object from top, front, and right sides. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

8) Building on the knowledge of a two-dimensional drawing, create complex isometric (3-D pictorial) drawings, properly using lines (e.g., object, hidden, center), labels, and dimensioning techniques. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

9) Use CAD software to create simple two-dimensional and three-dimensional drawings, accurately incorporating labels, notes, dimensioning, and line types to design drawings. Perform basic operations such as creating, saving files, opening files, storing files, and printing. (TN Reading 3, 4, 5, 7; TN Writing 4; TN Math G-MG)

**Students who successfully completed Principles of Engineering and Technology *will already have foundational skills in Engineering Drawing, however these concepts should be reviewed. If students have not taken the* Principles *class, please cover these standards in full.*

Work, Force, Power & Machines

10) Drawing on relevant technical documents, define and identify at least one application for each of the six simple machines listed below. Describe each with sketches and proper notation in an engineering notebook.
   a. Inclined plane
   b. Wedge
   c. Lever
   d. Wheel and axle
   e. Pulley
   f. Screw
   In addition, define a combination of two or more simple machines working together as a compound machine, and identify at least one application of the compound machine. (TN Reading 1; TN Writing 2, 4, 7)

11) In teams, document the process of completing a simple project, such as building or using one or more simple machines. Participate in and describe each engineering design process step in an engineering notebook. Create a physical prototype or model based on the constraints specified in the project and the data gathered in the process of development. (TN Reading 3, TN Writing 2, 7)

12) Calculate force, work, and power, and apply these formulae to solve engineering problems as outlined by the instructor. Articulate specific scenarios in which an engineer must calculate force, work, and power. (TN Reading 3, 4, 5; TN Math N-Q)

13) Calculate the ideal mechanical advantage and actual mechanical advantage, and explain to classmates what this concept means in the context of engineering. Given a specified engineering problem, calculate the efficiency of a machine when the ideal mechanical advantage and actual mechanical advantage are known. (TN Reading 5; TN Math N-Q, A-SEE, A-CED, A-REI)

Mechanisms

14) Explain the definition of a mechanism. Interpret technical information in design problems to identify types of mechanisms such as:
   a. Linkages
   b. Cam and follower
   c. Bearings
   d. Gears
   e. Sprockets and chain
   f. Drives

   Explain the typical application and operation in systems of the components listed above, citing measurement and/or observed evidence to support explanations. (TN Reading 1, 4, 5; TN Writing 2)

15) Create equations that describe relationships to solve engineering problems using formulae such as gear ratio, speed ratio, torque, and torque ratio. For example, understand that if a gear ratio is 2, the input gear must make two complete revolutions to every one revolution that the output gear makes. (TN Reading 4, 5; TN Math A-CED)

Energy

16) Write an explanatory text defining energy, in particular its use in engineering, drawing on engineering texts and other technical documents. In addition, identify and explain the different forms of energy. The explanation should include the categorization of various forms of energy such as potential or kinetic. (TN Reading 2, 4, 5; TN Writing 2, 4)

17) Draw on engineering texts and other technical documents to synthesize and explain the concept of heat. Include definitions of the different temperature scales such as Fahrenheit, Celsius, and Kelvin. Furthermore, explain the three forms of heat transfer: conduction, convection, and radiation. (TN Reading 2, 4; TN Writing 2, 4, 8)

18) Understand and solve problems in specific engineering contexts involving conversion from one unit of energy such as British Thermal Units (Btu), Joule (J), and Calorie (cal) to another. Use this information to calculate the heat needed to change temperature. (TN Reading 3, 4, 5; TN Math N-Q)

19) Research print and electronic sources published by government, nonprofit, or engineering organizations to define different renewable energy sources such as biomass, hydroelectric power, geothermal, wind, and solar, as well as nonrenewable energy sources such as petroleum, natural gas, coal, and nuclear energy. In teams, create and deliver a presentation justifying the use of one energy source for their local community; the presentation must contain at least one summary table or graphic. In addition, the presentation should provide an analysis demonstrating the advantage of their selected source over others. (TN Reading 1, 2, 4, 7, 9; TN Writing 1, 4, 5, 7, 8, 9)

Electrical Systems

20) Write a technical report describing the subatomic particles (e.g., nucleus, proton, neutron, and electron) that make up an atom. Moreover, cite technical texts to explain how the particles relate to electricity, including characteristics that make materials either conductors or insulators, and explain the relationship between the flow of charge and electrical current at the subatomic and atomic level. (TN Reading 2, 4, 5; TN Writing 2, 9)

21) Write an explanatory paper defining, comparing, and contrasting voltage, current, and resistance, incorporating appropriate graphic illustrations (such as diagrams) to complement the narrative. Identify sources of voltage as well. For example, a battery is a source of voltage, and one end of the battery represents a positive charge, while the other end represents a negative charge. (TN Reading 4, 5, 7; TN Writing 2, 9; TN Math N-Q)

22) Calculate voltage, current, and/or resistance in a DC circuit using Ohm's law (V = IR). Explain how Ohm's Law relates voltage, current, and resistance, citing technical examples for illustration. For example, if voltage remains constant and resistance decreases, the current will increase. Given a physical circuit, demonstrate how to measure each using a digital multimeter. Where unexpected behavior is observed, cite specific evidence to explain the observations. Prepare an informative report comparing calculated values with measured values and include an explanation of any sources of error. (TN Reading 1, 4, 5, 9; TN Writing 2, 4, 7; TN Math N-Q)

23) Explain how series and parallel circuits function, including identification of their chief components, characteristics, and differences. Solve problems involving series and parallel circuits including calculating equivalent resistance and calculating voltage and/or current through elements within a circuit. (TN Reading 3, 4, 5; TN Writing 4; TN Math N-Q, A-SEE, A-CED)

Computer Software for Engineering Problem Solving

24) Use computer tools, such as spreadsheet software (e.g., Microsoft Excel), analytical/scientific software (e.g., MATLAB), and/or programming software (e.g., Microsoft Visual Basic) to solve at least one problem from the content described in the standards above. Examples may include the use of spreadsheets to input data from experimental tests and create graphs for presentation, or the use of MATLAB to solve a system of equations. (TN Reading 5, 7; TN Writing 9)

Team Project

25) As a team, identify a problem in the school or community. Draft a problem statement to guide a project incorporating engineering concepts from at least three of the content sections (i.e., electrical systems, energy, mechanisms, etc.) outlined above. Follow the engineering design process to solve the problem. Each team will develop a paper following the format of a typical technical report (see components of the report below). Upon completion of the report, create and deliver a presentation for a CTSO event using appropriate citation conventions. Refine the report as would a team of engineers by incorporating feedback from the presentation.

   The written report should include, but is not limited to:
   a) Background

b) Problem definition
c) Design constraints
d) Methodology
e) Data analysis (e.g., charts, graphs, calculations)
f) Results/Problem solution (including engineering drawings)
g) Conclusions and recommendations for future research.
~~(TN Reading 1, 3, 4, 5, 7, 9; TN Writing 2, 5, 6, 7, 8, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. While not aligned to one specific conceptual category, students who are engaging in the activities outlined above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Engineering Design II

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6140
Prerequisite(s):	*Engineering Design I* (6139) and *Biology* (3210) or *Chemistry* (3221)
Credit:	1
Grade Level:	11
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the third course in the *Engineering* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students may be qualified to sit for the American Design Drafting Association (ADDA) Certification Exam upon completion of the *Engineering Design* program of study.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 413, 414, 415, 416, 417, 418, 230, 232, 233, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Approved April 10, 2015; Amended April 15, 2016

Course Description

Engineering Design II is an applied course in the STEM career cluster for students interested in further developing their skills as future engineers. This course covers knowledge, skills, and concepts required for postsecondary engineering and technology fields of study. Upon completion of this course, proficient students are able to explain the differences between scientists and engineers, understand the importance of ethical practices in engineering and technology, identify components of control systems, describe differences between laws related to fluid power systems, explain why material and mechanical properties are important to design, create simple free body diagrams, use measurement devices employed in engineering, conduct basic engineering economic analysis, follow the steps in the engineering design process to complete a team project, and effectively communicate design solutions to others. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Students are expected to use engineering notebooks to document procedures, design ideas, and other notes for all projects throughout the course.

Program of Study Application

This is the third course in the *Engineering* program of study. For more information on the benefits and requirements of implementing this program in full, visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Career Exploration

3) In teams, research various sources to determine the differences between engineers and scientists. Create a brochure that would be appealing to middle school students to educate them on the differences between the roles and activities of engineers and scientists. As an extension activity, prepare a presentation, using the brochures, to present to local middle school students. ~~(TN Reading 1, 5, 7, 9; TN Writing 2, 4, 6, 8)~~

4) Research various engineering job responsibilities (such as research engineer, development engineer, testing engineer, design engineer, analysis engineer, systems engineer, manufacturing engineer, operations and maintenance engineer, technical support engineer, sales engineer, and

engineering manager) and present the characteristics of each. Also, describe how these job responsibilities are applied in industry. Use a variety of sources to gather data, cite each source, and briefly explain why each source is reliable. (TN Reading 1, 5, 7, 9; TN Writing 2, 4, 6, 8)

Engineering Ethics

5) Write an explanatory text defining ethics in the context of engineering practice, comparing and contrasting ethical standards with morals, personal standards, and legal standards. Include reasons and examples why ethical standards take precedence over personal and legal standards in engineering (TN Reading 1, 2; TN Writing 2, 4, 7)

6) Research print and electronic media to identify an issue related to ethics and engineering (for example, the decision to launch the space shuttle Challenger in cold temperatures). As a team, use the National Society of Professional Engineers (NSPE) Code of Ethics as a framework and develop a presentation displaying arguments on multiple sides of the selected issue or product. Teams should present their findings to the class and other audience members. (TN Reading 1, 2, 6, 7, 8, 9; TN Writing 1)

Control Systems

7) Prepare an explanatory text defining a system and identifying the components of a system (i.e., input, output, process, feedback) using a specific example such as: if an automobile is a system, the driver provides the input by turning the steering wheel to the left; the car converts input to process; the car then delivers the output by changing direction from straight to left. Convert the description to an illustration of the system. (TN Reading 1, 2, 4, 7; TN Writing 2, 4)

8) Define, compare, and contrast processors and controllers; further, define, compare, and contrast microcontrollers, computer-based controllers, and programmable logic controllers, citing examples of how each is used. (TN Reading 1, 2, 4, 5; TN Writing 2, 4, 7)

9) Define, compare, and contrast open-loop and closed-loop systems. Use responsible internet searches to find examples of both open- and closed-loop system diagrams, and explain why they are either open- or closed-loop. Use an online editing tool to develop an informational paper or infographic illustrate the difference between open- and closed-loop systems, supplying examples for each. (TN Reading 1, 2, 5, 7; TN Writing 2, 4, 6, 7, 8)

Fluid Power Systems

10) Define fluid power; define, compare, and contrast the two categories of fluid power: pneumatic and hydraulic. Compare and contrast hydrostatics and hydrodynamics. Compare and contrast fluid flow rate and fluid velocity. Compare and contrast the three types of air pressure: atmospheric, gauge, and absolute. Demonstrate the use of the appropriate formulae for each concept. (TN Reading 1, 2, 4, 5; TN Writing 2, 4, 7; TN Math N-Q)

11) Using various sources such as the internet and textbooks, research various applications of Bernoulli's principle and identify specific examples to demonstrate the principle. Develop and lead a lab activity to teach Bernoulli's principle to the class. (TN Reading 4, 5, 7)

12) Given a confined gas, explain the differences between the following laws: Boyle's, Charles', Avogadro's and Gay-Lussac's. Identify an online demonstration or prepare a demonstration of one (or more) of these laws and document each step of the law(s). Use an online editing tool to create a single written informative text with links to virtual demonstrations. (TN Reading 1, 2, 4, 5; TN Writing 2, 6, 7, 8; TN Math N-Q)

Materials and Mechanical Properties

13) Define the following and describe differences among terms dealing with strength and testing of materials (e.g., ductility, brittleness, hardness, elasticity, electrical conductivity, thermal conductivity, stress, strain, and shear stress). Explain why each factor is important to consider in a design. Research various sources and identify a demonstration of a design or material failing due to one of these characteristics; write an introduction to the topic and include the link to the video or demonstration. (TN Reading 1, 2, 4; TN Writing 2, 4, 7)

14) As a team, use an online editing tool to develop an informational paper or infographic illustrating how raw materials are processed to make products and systems, and how each of these materials or products are used in society. Students should identify milestone developments (e.g., cast iron, paper, battery, and fiberglass) made possible after specific materials were developed. Metals, ceramics, polymers, and composites should be included. Select a material that is one of the most valuable materials ever discovered or manufactured, and use the online editing tool to prepare a persuasive paper supporting the claim. (TN Reading 1, 2, 5, 7, 9; TN Writing 1, 4, 6, 7, 8, 9)

Statics, Kinematics and Trajectory Motion

15) Define a projectile. Define, compare, and contrast kinematics and kinetics. Explain why a projectile travels along a parabolic curve. Solve fundamental projectile motion problems such as the initial horizontal velocity, initial vertical velocity, time for projectile to reach maximum height, maximum height reached by projectile, total flight time of projectile, distance projectile will travel horizontally, and firing angle. For example, given initial horizontal and vertical velocity of a projectile, use a graphical tool (i.e., Microsoft Excel or MATLAB) to graph the path of the projectile by programming equations defining the path. (TN Reading 3, 4, 7; TN Math N-Q, A-SEE, A-CED, F-IF, F-BF)

16) Given a scenario of a stationary object with forces applied, construct a simple free body diagram, graphically illustrating the magnitude and direction of all forces acting upon the object. Demonstrate that the sum of the force vectors is equal to 0 for a stationary object. If the sum of the force vectors does not equal zero, explain the resulting motion of the object. (TN Reading 3, 4, 7; TN Writing 4; TN Math N-VM)

Introduction to Statistics and Quality

17) Given a dataset, calculate mean, mode, median, standard deviation, and range using algebraic/statistical reasoning and engineering software such as Microsoft Excel. Generate a graphical representation of the dataset including results of these statistics in a format suitable for a technical report. (TN Reading 1, 3, 4; TN Writing 4; TN Math A-SSE, S-ID)

18) In teams, prepare an informative report on the importance of quality management in the context of product design, process planning, and manufacturing implementation. For example, research and describe, through class discussion, the aspects of Joseph Juran's trilogy of quality planning, quality control, and quality improvement; sampled inspection during manufacturing and the use of the Taguchi method to minimize sampling; or the concept of 6-sigma in manufacturing. Prepare and deliver a presentation to the class, and incorporate visuals and information from print and electronic resources. (TN Reading 1, 2, 6, 7, 9; TN Writing 2, 4, 6, 7, 8, 9)

Engineering Economics

19) Assess the impact of materials costs and manufacturing/construction costs in the development and determination of the best design solution. Apply techniques of engineering economics to guide design decisions. For example, understand how to use value and interest; cash flow diagrams; cash flow patterns; equivalence of cash flow patterns; unusual cash flows; and interest periods to make design solution decisions. (TN Reading 2, 3, 7, 9; TN Writing 4, 6; TN Math S-IC, F-IF)

Projects

20) Explore how teams are formed in order to design solutions to engineering problems. Using a scholarly database such as the Education Resources Information Center (ERIC), or searching on the websites of research institutions or other organizations, investigate a well-known team of engineers (for example, the team that raised the Costa Concordia shipwreck) and report to the class on how they collaborated to solve an engineering problem. (TN Reading 2, 4; TN Writing 2, 4, 7)

21) As a team, identify a problem in the school or community; draft a problem statement to guide a project incorporating engineering concepts from at least three of the content sections outlined above (engineering economics **must** be included). Follow the engineering design process to solve the problem. Each team member will develop a paper following the format of a typical technical report (see components of the report below). Upon completion of the report, create and deliver a presentation for a CTSO event using appropriate citation conventions. Then, each team member will refine his/her report, incorporating feedback from the presentation.

The written report should include, but is not limited to:
   a. Background
   b. Problem definition
   c. Design constraints
   d. Methodology
   e. Data analysis (e.g., charts, graphs, calculations)
   f. Cost analysis (using engineering economics concepts)
   g. Results/Problem solution (including engineering drawings)
   h. Conclusions and recommendations for future research
(TN Reading 1, 3, 4, 5, 7, 9; TN Writing 2, 5, 6, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- National Society of Engineers (NSPE) Code of Ethics. (2014). http://www.nspe.org/resources/ethics/code-ethics.

Robotics & Automated Systems

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6143
Prerequisite(s):	*Digital Electronics* (5925); *Algebra I* (3102); *Geometry* (3108); *Physical Science* (3202); and *Chemistry* (3221) or *Physics* (3231)
Credit:	1
Grade Level:	11
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the third course in the *Technology* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 470, 477, 519, 531, 535, 537, 582, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

Robotics & Automated Systems is an applied course for students who wish to explore how robots and automated systems are used in industry. Building on the content and critical thinking frameworks of *Principles of Engineering* and *Digital Electronics*, this course asks students to follow the engineering

Approved April 11, 2014; Amended April 15, 2016

design process and apply basic programming skills to complete assignments and projects. Upon completion of this course, proficient students will have an understanding of the historical and current uses of robots and automated systems; programmable circuits, interfacing both inputs and outputs; ethical standards for engineering and technology professions; and testing and maintenance of robots and automated systems.

Note: Standards in this course are presented sequentially for students' learning progression; however, instructors may tailor the order of course standards to their specifications. Students are expected to use engineering notebooks to document procedures, design ideas, and other notes for all projects throughout the course.

Program of Study Application

This is the third course in the *Technology* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. (TN Reading 2, 3, 4, 5, 6)

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. (TN Reading 3, 4)

Robotics Overview

3) Research the historical use of robotics from textbooks, news media, and other informational texts. Create a presentation concerning the various uses of robotics. For example, explore areas such as the surgical field, space exploration, agriculture, and advanced manufacturing. (TN Reading 1, 2, 4, 7; TN Writing 4, 7)

4) Write a persuasive essay explaining why robots should be used in certain circumstances. Cite textual evidence to support claims (for example, assemble evidence from medical journals to support a claim that the use of robots has lowered costs and increased efficiency among medical providers). Other examples may derive from the areas identified in standard 3. During a class discussion, defend original arguments and debate peer perspectives using claim(s) and counterclaim(s) developed in the persuasive essay. (TN Reading 1, 4, 7, 8; TN Writing 1, 4, 7, 9)

Career Exploration

5) Create a presentation illustrating industries, organizations, and careers in Tennessee and other states that use robotics (such as Nissan in Automotive Manufacturing). Include work activities involved, postsecondary education needed, and skills necessary for these careers. (These could range from industry certifications to degrees in robotics engineering.) (TN Reading 2, 4; TN Writing 2, 4, 7, 8)

6) Research the ethical considerations involved in developing new and modifying existing technologies. For example, investigate the National Society of Professional Engineers' (NSPE) Code of Ethics for Engineers or the Computer Ethics Institute's Ten Commandments of Computer Ethics. Select an existing technology and describe the ethical dilemmas faced by both producers and consumers of that technology, such as trade-offs between individual versus societal benefits or unforeseen consequences to the environment. For example, examine why some workers and labor unions may view robots as a threat to their jobs. Present findings to the class in a format appropriate for a career and technical student organization (CTSO) event. (TN Reading 2, 4, 7; TN Writing 2, 4, 7, 9)

Programming

7) Create a flowchart of a program for a robotic system. Convert the flowchart into a working program. Test, modify, and optimize the program. Write a technical report evaluating the performance of the program. Support all claims with specific examples. (TN Reading 3, 4; TN Writing 1, 4)

8) Log, store, and export data received from two or more sensors (for example, vision/light, audio, and touch) in a robotic or automated system. Explain why these procedures would be useful and provide specific examples. (TN Reading 3, 4; TN Writing 4)

Engineering Design and Science & Engineering Practices

9) Compare and contrast the following engineering design process with the eight practices of science and engineering (Achieve, 2013). Based on observations, write a brief paper explaining how the engineering design process and the science and engineering practices overlap, and describe how they might be used in automated systems design. Present findings to the class and refine the paper based on feedback. (TN Reading 2; TN Writing 2, 5)

Engineering Design Process	Science and Engineering Practices
a) Identify the problem	a) Asking questions (for science) and defining problems (for engineering)
b) Identify criteria and specify constraints	b) Developing and using models
c) Brainstorm possible solutions	c) Planning and carrying out investigations
d) Research and generate ideas	d) Analyzing and interpreting data
e) Explore alternative solutions	e) Using mathematics and computational thinking
f) Select an approach	f) Constructing explanations (for science)

			and designing solutions (for engineering)
g)	Write a design proposal	g)	Engaging in argument from evidence
h)	Develop a model or prototype	h)	Obtaining, evaluating, and communicating information
i)	Test and evaluate		
j)	Refine and improve		
k)	Create or make a product		
l)	Communicate results		

Computers and Electronics

10) Create an explanatory presentation that describes the parts necessary to make a robot and distinguishes it from a computer and a non-robotic machine. Parts necessary to make a robot include: (1) having a microprocessor for a brain, (2) sensors for input and output, (3) controls, and (4) motors. The presentation should include an informative report that describes various types of sensors (for example, auditory, visual, heat, etc.) and a summary of how sensors provide input. It should also describe various types of output (for example, motors, mechanisms, speakers, light, etc.) and discuss how sensors provide output. (TN Writing 2, 4, 9)

11) Design, develop, and test a program to control a robotic system and robotic subsystems. The program should be able to receive data from a robot's input devices, process the data, and create outputs based on the inputs received. Present the robotic system to the class and provide details on the methodology used to design and develop the program, justifying selections as appropriate. (TN Writing 4, 5)

12) Utilize feedback loops in a robotic system. For example, create a demonstration scenario and program a robot that requires the following: start, stop, or change motion within a robotic or automated system based on sensor input, provided by two or more sensors (such as vision/light, audio, and touch). (TN Reading 3, 4; TN Writing 4, 5)

Mechanics

13) Use mechanical tools, such as motors, gears, and gear trains in the construction of a robotic or automated system. Identify where forces are acting upon various points on the system and document with simple diagrams. Use the concepts of force, torque, and mechanical advantage to calculate the force acting upon the points in the system. (TN Reading 3, 7; TN Writing 4; TN Math N-Q, A-REI)

14) Develop a system to demonstrate force, torque, work, and power acting upon or being done by a robotic or automated system. Justify the design by creating mathematical models that show the calculations. (TN Reading 3; TN Writing 4; TN Math N-Q, A-REI)

Testing, Maintenance, Documentation, and Quality Assurance

15) Use appropriate instruments to measure and record electrical, light, and audio outputs of a robotic system. Compare measured data to acceptable norms for the system. Document whether the system is performing within accepted parameters and cite evidence to support the claims. Perform maintenance or follow recommended procedures to correct malfunctions or underperformance within the system. Write a justification for any maintenance that is performed, citing data obtained from test results. (TN Reading 3, 4; TN Writing 1, 4)

16) Create a service and maintenance report on a robotic or automated system. The report should include text explaining the maintenance and corrective measures conducted. It should also include text justifying whether the system is functioning properly or recommending additional measures to correct any issues within the system. Finally, it should include text recommending quality-assurance policies and procedures to assure continuing operation of the system within acceptable parameters and text describing corrective procedures to be used when the system is malfunctioning or operating below optimal performance. (TN Reading 5; TN Writing 1, 2, 4, 5)

Projects

17) Working in a team, design and create a robotic solution to a given problem. Incorporate the engineering design process, as well as science and engineering practices, to develop a solution that meets the criteria for entries in a regional, state, or national robotics competition. Maintain an engineering notebook to document the details of the project. Write a technical paper (see components of the report below) and develop a presentation describing the solution and development process for the team solution.

The technical paper should include, but is not limited to:
   a) Background
   b) Problem definition
   c) Design constraints
   d) Methodology
   e) Data analysis (e.g., charts, graphs, calculations)
   f) Results/Problem solution (include engineering drawings)
   g) Conclusions and recommendations for future research
(TN Reading 1, 3, 4, 7, 9; TN Writing 2, 5, 6, 7, 8, 9)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.

- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and algebraic reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Engineering Practicum

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6141
Prerequisite(s):	*Engineering Design II* (6140) or *Robotics & Automated Systems* (6143)
Credit:	1
Grade Level:	12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the fourth course in the *Engineering* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Students may be qualified to sit for the American Design Drafting Association (ADDA) Certification Exam upon completion of the *Engineering Design* program of study.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 413, 414, 415, 416, 417, 418, 230, 232, 233, 470, 477, 519, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

Engineering Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous *Engineering* courses within a professional, working environment. In addition to developing an understanding of the professional and ethical issues encountered by engineers and technologists in the workplace, students learn to refine their skills in problem solving, research, communication, data analysis, teamwork, and project management. The course is highly customizable to meet local system needs: instruction may be delivered through school laboratory training or through work-based learning arrangements such as internships, cooperative education, service learning, mentoring, and job shadowing. Upon completion of the practicum, students will be prepared for postsecondary study in engineering and technology fields. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Mastery of the following standards should be attained while completing an engineering design project in a practicum setting. Students are expected to use engineering notebooks to document procedures, design ideas, and other notes for the project throughout the course. The project should follow the engineering design process learned in previous courses.

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *Engineering* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Career Exploration

3) Develop an informational annotated document, linked to bookmarked websites, illustrating the opportunities for students to investigate and experience engineering and technology while in school, focusing specifically on those programs offered by colleges and universities in Tennessee. For example, opportunities include job shadowing, internships, co-op programs, volunteer and community service, and part-time employment. ~~(TN Reading 5, 7, 9; TN Writing 2, 4, 6, 8)~~

Employment Research and Preparation

4) Research and select a company or organization for a work-based learning project in an engineering or technology area of choice. Cite specific textual evidence from the organization's literature, as well as independent news articles to summarize:
   a. The mission and history of the organization
   b. Headquarters and organizational structure
   c. Products or services provided
   d. Credentials required for employment and how they are obtained and maintained
   e. Policies and procedures
   f. Reports, newsletters, and other documents published by the organization
   g. Website and contact information
   ~~(TN Writing 4, 7)~~

5) Search for the resumes of engineers and technologists retrieved from the websites of institutions, organizations, or professional networks. Discuss what is typically included in the resumes of engineering and technology professionals, compare and contrast several examples, and create a personal resume modeled after elements identified in the search. ~~(TN Reading 1, 4, 5, 6; TN Writing 4)~~

6) Conduct a job search and simulate the experience by researching local employment options. In preparation for a future career in engineering or technology, complete an authentic job application form and compose a cover letter following guidelines specified in the vacancy announcement. ~~(TN Reading 7; TN Writing 4)~~

7) Participate in a mock interview. Prior to the interview, prepare a paper that includes the following: tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. ~~(TN Reading 2; TN Writing 2, 4, 7, 9)~~

Transferring Course Concepts to Practicum

8) Apply skills and knowledge from previous courses in an authentic work-based learning internship, job shadow, or classroom-based project. Where appropriate, develop, practice, and demonstrate skills outlined in previous courses. (TN Reading 2, 3)

9) Identify a problem faced by a local organization or company to define a project proposal. Incorporate organization or company interviews into the research, as well as engineering concepts from the prior three courses. Prepare a written project proposal including the problem definition; justification for why the problem is important to solve; design statement; criteria; constraints; information obtained through research; and deliverables. (TN Reading 3, 4, 7, 9; TN Writing 1, 5, 7)

10) Create and continually update a personal journal to document skills learned during the practicum and draw connections between the experience and previous course content by reflecting on:
    a. Tasks accomplished and activities implemented
    b. Positive and negative aspects of the experience
    c. How challenges were addressed
    d. Team participation in a learning environment
    e. Comparisons and contrasts between classroom and work environments
    f. Interactions with colleagues and supervisors
    g. Personal career development
    h. Personal satisfaction
    (TN Writing 2, 4)

Portfolio

11) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the engineering design process (depending on the nature of the work-based learning project). The following documents will reside in the career portfolio:
    a. Career and professional development plan
    b. Resume
    c. List of responsibilities undertaken through the course
    d. Examples of visual materials developed and used during the course (such as graphics, drawings, models, presentation slides, videos, and demonstrations)
    e. Description of technology used, with examples if appropriate
    f. Periodic journal entries reflecting on tasks and activities
    g. Feedback from instructor and/or supervisor based on observations
    (TN Writing 4, 5)

Communication of Project Results

12) Apply all steps of the engineering design process to successfully generate a prototype, collect the relevant data, perform the necessary tests, interpret the results, make modifications to models or prototypes, and communicate results over the course of the project's duration.

Produce a technical report documenting the findings of the project and justifying the final conclusions based on evidence obtained. ~~(TN Reading 1, 2, 3, 4, 5, 7, 8, 9; TN Writing 1, 2, 4, 5, 6, 7, 8, 9)~~

13) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, drawings, and models of project findings, and/or physical artifacts that represent the outcome of the project (i.e., a prototype or 3-D model). Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. ~~(TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
    - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
    - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. While not aligned to one specific conceptual category, students who are engaging in the activities outlined above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM I: Foundation

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6144
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the first course in the *STEM Education* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

STEM I: Foundation is a foundational course in the STEM cluster for students interested in learning more about careers in science, technology, engineering and mathematics. This course covers basic skills required for STEM fields of study. Upon completion of this course, proficient students are able to identify and explain the steps in both the engineering design and the scientific inquiry processes. They conduct research to develop meaningful questions, define simple problem scenarios and scientific investigations, develop fundamental design solutions, conduct basic mathematical modeling and data analysis, and effectively communicate solutions and scientific explanations to others. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: For clarity, some standards include example applications to science, technology, engineering, and mathematics. Teachers are encouraged to align instruction to one or more of these areas, depending on area of expertise and student interest.

Program of Study Application

This is the first course in the *STEM Education* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

STEM Fields Exploration

3) Research the history of science, math, and engineering related to technology. Examine how these technologies have evolved, and evaluate their influence on present-day society, citing specific textual evidence from news articles and scholarly journals. ~~(TN Reading 1, 2; TN Writing 2)~~

4) Explore several occupations within the STEM field (such as manufacturing, computer science/programming, aviation, forensics, health science, engineering, transportation/ distribution & logistics, actuarial science) and describe the many sources and types of information that these occupations use. Determine how various industries employ different kinds of data to meet their needs. ~~(TN Reading 4, 6, 9)~~

5) Investigate an assortment of skills and education required for STEM professionals. Write an informative text that identifies the typical educational and certification requirements, working environments, and career opportunities for these occupations. For example, participate in an information-gathering tour of a local organization that uses computer-aided design, and report on the roles and responsibilities of STEM professionals on staff, including the kinds of software and equipment they use. (TN Reading 2; TN Writing 2)

Problem-Resolution Skills

6) Research the terms engineering design and scientific inquiry. Compare and contrast the steps of the engineering design process to the steps of the scientific inquiry in a graphic illustration or presentation. (TN Reading 2, 7, 9; TN Writing 2, 8)

7) Evaluate a question to determine if it is testable and can produce empirical data. Plan an investigation that outlines the steps of the design process to collect, record, analyze, and evaluate data. For example,
   a. Given a set of symptoms, determine whether there is enough data to diagnose a medical condition as would a physician or nurse practitioner. (Science)
   b. Determine the information necessary in order to design a vehicle to carry a specified payload a designated distance in the least amount of time like a mechanical engineer. (Technology/Engineering)
   c. Determine what information an actuary would need to know in order to answer a research question about which factors (accident, sickness, disability, etc.) are contributing the most to medical insurance claims in a region. (Mathematics)
   (TN Reading 1, 7, 8; TN Writing 4, 7)

8) Given a real-world problem, identify several possible solutions using both the engineering design process and the scientific inquiry. For example,
   a. Research several treatment plans for a severe allergy sufferer as would a biochemist or biophysicist. (Science)
   b. Investigate a variety of materials suitable for building structures to withstand earthquakes as would a civil engineer. (Technology/Engineering)
   c. Explore commonly used methods to safeguard computer files against accidental or unauthorized alteration, destruction, or disclosure as would an information security analyst. (Technology/Mathematics)
   (TN Reading 3, 8; TN Writing 7, 8)

9) Analyze solutions to a real-world problem collaboratively, to identify critical factors of the steps of the design process. Explain why these factors are critical. For example,
   a. Research types of prosthetics and submit a proposal for which one most effectively uses the design process in terms of feasibility, cost, safety, aesthetics, and durability like a biomedical engineer. (Science)
   b. Research ways a chemical engineer performs tests and monitors performance of processes throughout the stages of production for manufacturing chemicals and products such as gasoline, synthetic rubber, plastics, detergents, cement, paper, and pulp. Submit a proposal for which one most effectively uses the design process in terms

of factors like mixing, crushing, heat transfer, distillation, and drying. (Technology/Engineering)

    c. Investigate the development and use of models such as diagrams, simulations, graphs, and equations to represent findings from either science or engineering research. Critique others' proposals by providing specific arguments for or against their reasoning and methodology as would a statistician. (Technology/Mathematics)

~~(TN Reading 1, 2, 8; TN Writing 1, 2, 8, 9)~~

Critical Thinking in Context

10) Given a real-world STEM scenario, identify the problem and develop meaningful questions. Differentiate between necessary and non-essential information as well as needs and wants for applying the scientific method of investigation or the engineering design process. For example, evaluate a STEM scenario related to one of the following:

    a. Environmental scientists perform tests on the quality of water in oceans, lakes, beaches, ponds, rivers, etc. Compare and contrast the pros and cons of using a satellite to provide real time data of water conditions in order to determine its validity as a resource for environmental engineers. (Science)

    b. The organization Engineers Without Borders implements projects worldwide to provide clean drinking water to developing nations. Identify the conditions and information collected in order to provide a sustainable water source to a rural farming community. (Technology/Engineering)

    c. Robots need to be programmed to perform specific tasks in harsh working conditions such as welding parts in an automobile assembly line operation. Compare and contrast the pros and cons of using robots versus humans in a manufacturing facility. (Technology/Mathematics)

~~(TN Reading 1, 4, 5, 9; TN Writing 2)~~

11) Design and develop several solution prototypes, conduct feasibility testing, and use the data to justify the solution selected. For example,

    a. Use a construction set to efficiently build a vehicle at low cost, and to travel a straight path with predictability. (Science)

    b. Using readily available, low cost materials, design a water filter in a soda bottle that lets as much water through as possible, but also removes as much particulate matter as possible as would a civil engineer. (Technology/Engineering)

    c. Design and construct a robot to maneuver through a given obstacle course. Use circumference of the wheels and distance needed to travel to calculate how many rotations the wheels need to make. Justify the solution selected for the robot to maneuver most efficiently through the course. (Technology/Mathematics)

~~(TN Reading 8, 9; TN Writing 1)~~

12) Collaborate to write a fictional, yet plausible, STEM problem-based scenario. Evaluate possible solutions, aligning work with the steps of the scientific method or the engineering design process. Consider possible constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. Sample scenarios might include the following:

    a. A scenario to diagnosis and identify a method of treatment for an illness based on several physical symptoms. (Science)

       b. A scenario that requires the design of a self-sustaining city for humans living on another planet. (Technology/Engineering)

       c. A scenario that requires calculation of an investment of an inheritance so that its growth is maximized by a certain time. (Mathematics)

13) Conduct research to create a list of problems that are considered major global challenges. Choose one to analyze. Evaluate possible solutions, aligning work with the steps of the scientific method or the engineering design process. Consider possible constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. Identify trade-offs and defend decisions that were made as a result of those trade-offs. Possible global challenges could include the following:

       a. Scientists work to address the threat of a global pandemic or issues related to food security. (Science)

       b. Engineers work to address issues related to climate change and global warming, global water shortages, and the need for alternative energy sources. (Technology/Engineering)

       c. Statisticians work on projects related to national and international debt, the global population, or workforce imbalances and lack of jobs worldwide. (Mathematics)

STEM Field Readiness

14) Sort and evaluate data for its significance and/or meaning in the process of solving a problem as a STEM professional would. Examine the data in ways that reveal the relationships, patterns, and trends that can be found within it. Differentiate between quantitative and qualitative data. For example,

       a. Environmental scientists collect, synthesize, analyze, manage, and report environmental data, such as pollution emission measurements, atmospheric monitoring measurements, meteorological or mineralogical information, and soil or water samples. (Science)

       b. Aerospace engineers identify information by categorizing, estimating, recognizing differences or similarities, and detecting changes in circumstances or events. They are also expected to evaluate product data and design from inspections and reports for conformance to engineering principles, customer requirements, and quality standards. (Technology/Engineering)

       c. Economists study economic and statistical data in various areas of specialization, such as finance, labor, or agriculture. They also compile, analyze, and report data to explain economic phenomena and forecast market trends, applying mathematical models and statistical techniques. (Mathematics)

15) Identify multiple forms of data and list mechanisms for collection that are essential to solving a problem. Prepare written documentation to justify findings.

       a. Statisticians analyze outcomes such as employment and educational attainment by identifying data sources, such as public data sets available from the Census Bureau, or collecting original data from the field, in order to model relationships among variables.

       b. Engineers collect data such as ease of use, operation safety, material properties, and material costs in order to determine an optimal design solution from multiple ideas.

16) Use available data to create an original prototype/solution to a scenario.
    a. Biomedical scientists and biomedical engineers design and construct prototype implants to fill and stabilize a partial bone defect. (Science)
    b. Aerospace engineers test a drag device to slow a spacecraft and protect its cargo, as well as calculate the surface area and measure the mass of the spacecraft. (Science/Mathematics)
    (TN Reading 3, 8, 9; TN Writing 1, 9)

Cause and Effect Relationships in STEM

17) Analyze multiple aspects of a problem scenario to identify cause/effect patterns. Consider the history of a problem to identify factors such as risks and benefits.
    a. Aerospace engineers perform engineering duties in designing, constructing, and testing aircraft, missiles, and spacecraft. They conduct basic and applied research to evaluate adaptability of materials and equipment to aircraft design and manufacture, and recommend improvements in testing equipment and techniques. For example, variations in the nose and fins will result in different behaviors, so construction and testing of multiple designs is necessary. (Engineering)
    b. Apply standardized mathematical formulas, principles, and methodology to the solution of technological problems involving projectiles as a mathematical technician would. Use computer software to analyze the critical aspects of parabolic motion, for example: height at any given time, maximum height, maximum distance. (Technology/Mathematics)
    (TN Reading 1, 7, 8, 9; TN Writing 4, 9)

18) Explore mathematical models and/or computer simulations that are used by scientists and engineers to accurately predict the effect of components of their original prototype design. Examine a range of resources (e.g. texts, experiments, simulations) to consider which models are likely to be most efficient, economic, and beneficial. Write a justification to support the conclusion.
    a. Meteorologists interpret data, reports, maps, photographs, or charts to predict long- or short-range weather conditions, using computer models and knowledge of climate theory, physics, and mathematics. Investigate the use of mathematical or computer models for weather forecasting. (Science)
    b. Civil engineers and civil drafters use the computer as a problem-solving tool. They identify locations of forces (tension, compression, torsion, shear, and resonance) in their bridge designs. Investigate the use of software to make modifications to multiple properties and gain immediate access to cost analysis and forces data. (Engineering/Technology)
    (TN Reading 4, 5, 7, 8; TN Writing 1, 7, 8, 9)

19) Analyze data from scientific investigation or prototype testing and accurately identify the cause of the results. Examine constraints including cost, safety, reliability, and aesthetics. Consider social, cultural, and environmental impacts. Summarize findings using tables, functions, graphical representations, and written explanations.

a. Forensic scientists collect, identify, classify, and analyze physical evidence related to criminal investigations. They perform tests on weapons or substances, such as fiber, hair, and tissue, to determine significance to the investigation. (Science)

b. Police frequently use mathematics in the analysis of crime data. Data can be stored and interpreted using wavelets, probability, and statistics. It can be securely transmitted using prime numbers and cryptography. (Mathematics/Technology)

(TN Reading 3, 7, 8, 9; TN Writing 2, 8, 9)

Standards Alignment Notes

*References to other standards include:

- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.
- TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Geometry, Statistics and Probability.
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM II: Applications

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6145
Prerequisite(s):	*STEM I: Foundation* (6144); *Algebra I* (0842, 3102); and *Physical Science* (3202) or *Biology* (3210)
Credit:	1
Grade Level:	10
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the second course in the *STEM Education* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Approved April 10, 2015; Amended April 15, 2016

Course Description

STEM II: Applications is a project-based learning experience for students who wish to further explore the dynamic range of STEM fields introduced in *STEM I: Foundation*. Building on the content and critical thinking frameworks of *STEM I*, this course asks students to apply the scientific inquiry and engineering design processes to a course-long project selected by the instructor with the help of student input. Instructors design a project in one of two broad pathways (traditional sciences or engineering) that reflects the interest of the class as a whole; the students then apply the steps of the scientific inquiry or the engineering design process throughout the course to ask questions, test hypotheses, model solutions, and communicate results. In some cases, instructors may be able to design hybrid projects that employ elements of both the scientific inquiry and the engineering design process. Upon completion of this course, proficient students will have a thorough understanding of how scientists and engineers research problems and methodically apply STEM knowledge and skills; and they will be able to present and defend a scientific explanation and/or an engineering design solution to comprehensive STEM-related scenarios. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Standards in this course are presented sequentially according to the traditional steps followed in the scientific inquiry or engineering design process. While instructors may tailor the order of course standards to their specifications, it is highly recommended that they maintain fidelity to the overall process. In addition, instructors opting for either the Science Path or the Engineering Path do not have to teach to both sets of standards; they are presented in parallel fashion here for ease of comparison, should teachers wish to combine elements of each.

Program of Study Application

This is the second course in the *STEM Education* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

The Roles of Scientists and Engineers

Science Path	Engineering Path
1) Determine the scientist's role in explaining why phenomena occur in the natural world, justified by historical and current science knowledge. Research a known scientist and present in an informative paper, oral presentation, or other format his/her contributions to scientific knowledge. Include an outline of how the scientific inquiry process was used in his/her work. ~~(TN Reading 1, 2, 3, 8, 9; TN Writing 2)~~	1) Determine the engineer's role in developing solutions to design problems that are justified by scientific knowledge. Research a known engineer and present in an informative paper, oral presentation, or other format his/her designs and explain how they influenced technology in his/her field. Include an outline of how the design process was used in his/her work. ~~(TN Reading 1, 2, 3, 8, 9; TN Writing 2)~~

Questioning and Defining Problems

Science Path	Engineering Path
2) Engage in scientific inquiry by brainstorming for questions to understand how a certain phenomenon in the natural world works, to understand why a phenomenon occurs, or to determine the validity of a theory. ~~(TN Reading 4, 5, 9)~~	2) Ask clear, relevant questions that lead to defining a design problem. For example, questions should be testable and explore the requirements of a problem solution, but not define the methodology to solve the problem. ~~(TN Reading 4, 5, 9)~~
3) Research various sources (e.g., articles, end-uses, textbooks) and identify one or more questions that will guide a scientific investigation. For example, questions should be relevant, testable, and based on current scientific knowledge. ~~(TN Reading 1, 4, 5, 6, 9; TN Writing 1, 4)~~	3) Brainstorm for several problem solutions, then conduct research using various sources (e.g., articles, end-uses, textbooks) to generate more solution ideas. Justify ideas using evidence from the sources. ~~(TN Reading 1, 4, 5, 6, 9; TN Writing 1, 4)~~
4) Develop an original proposal as would a natural or social scientist that will guide the scientific inquiry and follow responsible ethical practices. For example, the proposal should outline the reason for the research interest, hypothesis, methodology, data analysis, importance of study, and deliverables. ~~(TN Reading 3, 4, 7, 9; TN Writing 1, 7)~~	4) Develop a design brief that will guide a design process and follow responsible ethical practices. For example, the design brief should outline a problem definition, design statement, criteria, constraints, and deliverables. ~~(TN Reading 3, 4, 7, 9; TN Writing 1, 7)~~

Modeling

Science Path	Engineering Path
5) Create models to illustrate questions and represent processes or systems that are justified by scientific evidence. For example, models can be diagrams, drawings, or scaled down physical representations. ~~(TN Reading 1, 4, 7; TN Writing 4, 8, 9)~~	5) Create models to illustrate design criteria and represent processes, mechanisms, or systems. For example, models can be drawings, mathematical representations, or computer simulations. ~~(TN Reading 1, 4, 7; TN Writing 4, 8, 9)~~
6) Use mathematics and technology to develop multiple models to predict an occurrence in the natural world. Compare and contrast the recorded observations from each model. For example, computer modeling can be used to analyze current	6) Identify and sketch at least three alternative solutions, to a problem, that consider analyses such as mechanical and electrical systems. For example, computer modeling can be used to analyze the effect of stress and strain on a

Science Path	Engineering Path
atmospheric conditions to predict the weather in days ahead. ~~(TN Reading 7, 9; TN Writing 7, 9)~~	beam. ~~(TN Reading 7, 9; TN Writing 7, 9)~~
7) Analyze results from modeling and appropriately determine when it is necessary to revise questions. Justify revisions with evidence. ~~(TN Reading 7, 9; TN Writing 9)~~	7) Conduct iterations of modeling a solution to a design problem, demonstrate that design criteria are met, and select a reliable design approach. ~~(TN Reading 7, 9; TN Writing 9)~~

Planning & Investigating

Science Path	Engineering Path
8) Make a hypothesis that explains a scientific question, plan and conduct a simple investigation, and record observations (e.g., data) in a manner easily retrievable by others. ~~(TN Reading 3; TN Writing 4)~~	8) Develop a design proposal to create prototypes for testing. The proposal should provide details such as drawings with dimensions, materials, and construction process. ~~(TN Reading 3; TN Writing 4)~~
9) Identify the independent variables and dependent variables in an investigation. Demonstrate the effects of a changing independent variable on a dependent variable, and observe and record results. ~~(TN Reading 3; TN Writing 7, 9)~~	9) Outline testing procedures that identify type of data (e.g., number of trials, cost, risk, and time) that is needed to produce reliable measurements and the specifications (e.g., effectiveness, efficiency, and durability) to determine whether a design has exceeded or failed expectations. ~~(TN Reading 3; TN Writing 7, 9)~~

Data Analysis & Interpretation

Science Path	Engineering Path
10) Use mathematics to represent and solve scientific questions. For example, simple limit cases can be used to determine if a model is realistic. ~~(TN Reading 3, 7)~~	10) Use mathematics to represent and solve engineering problems. For example, simple limit cases can be used to determine if a model is realistic. ~~(TN Reading 3, 7)~~
11) Evaluate data and identify any limitations of data analysis. Using this information, determine whether to make scientific claims from data or revise an investigation and collect more data. ~~(TN Reading 3, 7; TN Writing 7)~~	11) Evaluate data and identify any limitations of data analysis. Using this information, determine whether a design solution is optimal or should be refined and tested again. ~~(TN Reading 3, 7; TN Writing 7)~~

Science Path	Engineering Path
12) Compare and contrast the data results from multiple iterations of a scientific investigation. For example, consider how well each explanation is supported by evidence, prior research, and scientific knowledge. (TN Reading 3, 7, 9; TN Writing 1)	12) Compare and contrast the data results from testing multiple design solutions. For example, consider how well each design solution meets the design criteria and constraints. (TN Reading 3, 7, 9; TN Writing 1)

Problem Solutions & Scientific Explanations

Science Path	Engineering Path
13) Develop an explanation to a scientific question that is logically consistent, peer reviewed, and justified by data analysis and scientific knowledge. (TN Reading 4, 7, 9; TN Writing 1, 5, 7, 8, 9)	13) Develop an optimal design solution that is justified by data analysis and scientific knowledge, and meets ethical and design criteria and constraints. (TN Reading 4, 7, 9; TN Writing 1, 7, 8, 9)

Communicating Solutions & Explanations

Science Path	Engineering Path
14) Develop a technical report to communicate and defend a scientific explanation and justify its merit and validity with scientific information. Consider the ethical implications of the findings. The report can include tables, diagrams, graphs, procedures, and methodology. For example, conduct a STEM forum, present scientific research, and provide evidence to support arguments for or against scientific solutions. (TN Reading 4, 7, 9; TN Writing 1, 5, 6, 7, 8, 9)	14) Develop a design document to communicate the final design solution and how well it meets the design criteria and constraints. For example, the design document can include charts, graphs, calculations, engineering drawings, as well as information regarding marketing, distribution, and sales. For example, conduct a STEM forum, present engineering design briefs, and provide evidence to support arguments for or against design solutions. (TN Reading 4, 7, 9; TN Writing 1, 5, 6, 7, 8, 9)

Safety

15) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. (TN Reading 3, 4, 6)

16) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM III: STEM in Context

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6146
Prerequisite(s):	*STEM II: Applications* (6145) and *Biology* (3210) or *Chemistry* (3221)
Credit:	1
Grade Level:	11
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the third course in the *STEM Education* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend the training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

STEM III: STEM in Context is an applied course in the STEM career cluster which allows students to work in groups to solve a problem or answer a scientific question drawn from real-world scenarios within their schools or communities. This course builds on *STEM I: Foundation* and *STEM II: Applications* by applying scientific and engineering knowledge and skills to a team project. Upon completion of this course, proficient students will be able to effectively use skills such as project management, team communication, leadership, and decision making. They will also be able to effectively transfer the teamwork skills from the classroom to a work setting. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Mastery of the following standards should be attained while completing a STEM project that follows the scientific inquiry or engineering design process. This course prepares students for the STEM IV: STEM Practicum course.

Program of Study Application

This is the third course in the *STEM Education* program of study. For more information on the benefits and requirements of implementing this program in full, visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Essential Components of STEM Research

3) Explore how research teams are formed in order to answer scientific questions or design solutions to engineering problems. Using a scholarly database such as the Education Resources Information Center (ERIC), or searching on the websites of universities and other research institutions, investigate a well-known team of scientists or engineers (for example, the most recent Nobel Prize-winning teams in the sciences) and report to the class on how they collaborated to produce new scientific knowledge or solve an engineering problem. ~~(TN Reading 2, 4; TN Writing 2, 4, 7)~~

4) Research the ethical requirements for conducting scientific research or testing a prototype that will involve the public. For example, investigate the process for obtaining Institutional Review Board (IRB) approval when proposing a biomedical or human behavioral research study.

Describe the concept of risk-benefit analysis in the production of new scientific knowledge; detail the rights and responsibilities of researchers—and, if applicable, their subjects—as they relate to conducting research in STEM fields. (TN Reading 2, 4, 7; TN Writing 2, 4, 7)

5) Examine how scientists, engineers, and other STEM professionals obtain funding, seek sponsorship, and/or gain approval to conduct their research. Explore websites such as the National Science Foundation or the National Institutes of Health to identify common processes around submitting proposals for research studies and procuring the necessary funds. Explain specific terminology such as request for proposals (RFP), competitive grants versus formula grants, and seed funding. (TN Reading 2, 4, 6; TN Writing 2, 4, 7)

Research & Project Definition

6) Survey and observe people in your school and/or community. Analyze the results to determine potential STEM problems that need investigating or solving. Use these ideas to conduct research to determine and define a team project. Using supporting evidence from the research, write and present a STEM project proposal defining the project's purpose and goals. Include an outline of how the team intends to follow the scientific inquiry or engineering design process. (TN Reading 3, 4, 7, 9; TN Writing 1, 7, 8)

Team Development

7) Define the team norms, or the set of team values, that are understood and approved by all team members. The norms should include the team's mission and guidelines for how team members will treat each other. Create a team handbook and include the documented team norms. (TN Writing 2, 4, 5, 6)

8) As a team, determine the professional attributes that must be embodied by team members in order to successfully complete the proposed project. Collaboratively develop a professionalism rubric with performance indicators for each attribute agreed upon. Include the rubric in the team handbook. Attributes may include the following:
    a. Effective communication
    b. Respect for fellow team members
    c. Ethical use of intellectual property and other project resources (including ethical treatment of test subjects, if applicable)
    d. Timely achievement of project deadlines and goals
    e. Collaborative and equitable distribution of work among all team members
    (TN Writing 4)

9) Identify the strengths and weaknesses of team members and organize the results into a graphic representation. Use the graphic representation to define the roles of each team member and create an organizational chart for the team handbook. For example, the strengths and weaknesses document will help identify the leader of the project team. (TN Reading 7; TN Writing 4, 6)

10) Research Tuckman's stage model for team development (i.e., forming, storming, norming, performing, and adjourning). Prior to starting the STEM project, understand and explain each

stage. After completing the project, write a brief evaluation of the team's growth at each stage. (TN Reading 2, 6; TN Writing 4, 9)

Communication

11) Develop a process for official team communication. Define and document format guidelines for various modes of communication such as written, verbal, and email. For example, distinguish between communication appropriate to use with a team member versus communication appropriate to use with a supervisor (teacher). Document the communication guidelines in the team handbook. (TN Writing 4, 5, 6)

12) Practice effective verbal, nonverbal, written, and electronic communication skills for working with team members while demonstrating the ability to: listen attentively, speak courteously and respectfully, discuss each member's ideas, resolve conflict, and reach a consensus for team progress. (TN Writing 4, 6)

13) Research various decision-making methods for teams, such as consensus, majority, minority, averaging, and expert. Practice using these various methods when team disagreements arise, determine which are most effective for the project team, and explain the reasoning. (TN Reading 2, 3)

Project Management

14) Perform an Internet search, interview local professionals, or consult industry journals to identify common principles of successful project management. Based on templates retrieved online or approved by the instructor, estimate a detailed project plan for the course-long project. The project plan should include at minimum the following: a schedule or Gantt chart outlining deliverables, complete with job assignments based on team member strengths and weaknesses; a tracker for progress toward goals; a time management component to log hours worked for each team member; and supporting diagrams, datasheets, and flowcharts illustrating essential stages in the process. (TN Reading 1, 4, 7; TN Writing 4, 6, 7)

15) Based on the project proposal and project plan, identify projected costs and estimate a hypothetical budget. The projected costs may include but are not limited to materials, labor, equipment, and travel. Create a method to track the actual costs. For example, spreadsheets can be used to analyze and track project expenses. (TN Reading 7; TN Writing 4, 9)

Project Completion and Presentation

16) Apply all steps of the scientific inquiry or the engineering design process (depending on the nature of the project) to successfully generate a hypothesis or prototype, collect the relevant data, perform the necessary tests, interpret the results, make modifications to models or prototypes, and communicate results over the course of the project's duration. Produce a technical report documenting the findings of the project and justifying the team's final conclusions based on evidence obtained. (TN Reading 3, 4, 5, 7, 9; TN Writing 1, 7)

17) As a team, design a presentation to communicate the results of the project to both a technical and a non-technical audience. The presentation should be delivered orally but supported by

relevant graphic illustrations, such as diagrams and models of project findings, and/or physical artifacts that represent the outcome of the project (i.e., a robotic prototype or a 3-D model). Prepare the presentation in a format that could be submitted to a competition such as a local Maker Faire or CTSO competitive event. (TN Reading 7; TN Writing 2, 4, 6)

Evaluation of Project Outcome

18) Using tools that were developed during the course (i.e., professionalism rubric, project plan, organizational chart, team development evaluation), write a reflection paper to evaluate the project team's performance. Present the STEM project and team evaluation to the class. The paper should address, but is not limited to the following:
   a. Did the team accomplish the project goal?
   b. How well did the team (collectively and individually) meet the performance indicators?
   c. How did the team develop throughout the duration of the project?
   d. How well did the team resolve disagreements?
   e. Was the team leadership effective?
   f. Was the project completed within budget?
   (TN Reading 7; TN Writing 2, 4, 6)

Standards Alignment Notes

*References to other standards include:
- TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
   - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 8 and 10 at the conclusion of the course.
- TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
   - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Geometry, Statistics and Probability.
   - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM IV: STEM Practicum

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	6147
Prerequisite(s):	*STEM III: STEM in Context* (6146)
Credit:	1
Grade Level:	12
Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM courses.
Programs of Study and Sequence:	This is the fourth course in the *STEM Education* program of study.
Aligned Student Organization(s):	Skills USA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend the training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

STEM IV: STEM Practicum is a capstone course intended to provide students with the opportunity to apply the skills and knowledge learned in previous *STEM Education* courses within a professional, working environment. In addition to developing an understanding of the professional and ethical issues encountered by STEM professionals in the workplace, students learn to refine their skills in problem solving, research, communication, data analysis, teamwork, and project management. The course is highly customizable to meet local system needs: instruction may be delivered through school laboratory training or through work-based learning arrangements such as internships, cooperative education, service learning, mentoring, and job shadowing. Upon completion of this course, proficient students will be prepared for postsecondary study in a STEM field. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Mastery of the following standards should be attained while completing a STEM project in a practicum setting. The project should follow the scientific inquiry or engineering design process learned in previous courses.

Work-Based Learning Framework

Practicum activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the fourth course in the *STEM Education* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4, 6)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures

with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)

STEM Employment Research and Preparation

3) Research and select a company or organization for a work-based learning project in a STEM area of choice. Cite specific textual evidence from the organization's literature as well as independent news articles to summarize:
   a. The mission and history of the organization
   b. Headquarters and organizational structure
   c. Products or services provided
   d. Credentials required for employment and how they are obtained and maintained
   e. Policies and procedures
   f. Reports, newsletters, and other documents published by the organization
   g. Website and contact information
   (TN Reading 1, 2; TN Writing 7)

4) Search for the resumes and curricula vitae (CVs) of scientists, engineers, and researchers retrieved from the websites of institutions, organizations, or professional networks. Discuss what is typically included in the resumes and CVs of STEM professionals, compare and contrast several examples, and create a personal resume or curriculum vitae modeled after elements identified in the search. (TN Reading 1, 4, 6, 9; TN Writing 4)

5) Conduct a job search and simulate the experience by researching local employment options. In preparation for a future career in STEM, complete an authentic job application form and compose a cover letter following guidelines specified in the vacancy announcement. (TN Reading 5, 7; TN Writing 4)

6) Participate in a mock interview. Prior to the interview, prepare a paper that includes the following: tips on dress and grooming, most commonly asked interview questions, appropriate conduct during an interview, and recommended follow-up procedures. Upon completion of the interview, write a thank you letter to the interviewer in a written or email format. (TN Reading 2; TN Writing 2, 4, 7, 9)

Ethics

7) Collect codes of ethics from various professions related to the STEM area of choice, such as the National Society of Professional Engineers (NSPE) Code of Ethics for Engineers and the American Society for Clinical Laboratory Science (ASCL) Code of Ethics. Participate in a class discussion on the significance of following ethical standards in the STEM fields. Synthesize principles from the codes investigated to create a personal code of ethics related to a STEM area of choice. (TN Reading 1, 2, 6; TN Writing 4, 9)

Transferring Course Concepts to Practicum

8) Apply skills and knowledge from previous courses in an authentic work-based learning internship, job shadow, or classroom-based project. Where appropriate, develop, practice, and demonstrate skills outlined from previous courses.

9) Create and continually update a personal journal to document the practicum and draw connections between the experience and previous course content by reflecting on:
    a. Tasks accomplished and activities implemented
    b. Positive and negative aspects of the experience
    c. How challenges were addressed
    d. Team participation in a learning environment
    e. Comparisons and contrasts between classroom and work environments
    f. Interactions with colleagues and supervisors
    g. Personal career development
    h. Personal satisfaction
    (TN Writing 2, 4)

Portfolio

10) Create a portfolio, or similar collection of work, that illustrates mastery of skills and knowledge outlined in the previous courses and applied in the practicum. The portfolio should reflect thoughtful assessment and evaluation of the progression of work involving the application of steps of the scientific inquiry or the engineering design process (depending on the nature of the work-based learning project). The following documents will reside in the career portfolio:
    a. Personal code of ethics
    b. Career and professional development plan
    c. Resume or Curriculum Vitae
    d. List of responsibilities undertaken through the course
    e. Examples of visual materials developed and used during the course (such as graphics, drawings, models, presentation slides, videos, and demonstrations)
    f. Description of technology used, with examples if appropriate
    g. Periodic journal entries reflecting on tasks and activities
    h. Feedback from instructor and/or supervisor based on observations
    (TN Reading 7; TN Writing 4)

Communication of Project Results

11) Apply all steps of the scientific inquiry or the engineering design process (depending on the nature of the project) to successfully generate a hypothesis or prototype, collect the relevant data, perform the necessary tests, interpret the results, make modifications to models or prototypes, and communicate results over the course of the project's duration. Produce a technical report documenting the findings of the project and justifying the final conclusions based on evidence obtained. (TN Reading 1, 2, 3, 4, 5, 7, 8, 9; TN Writing 1, 5, 6, 7, 8, 9)

12) Upon completion of the practicum, develop a technology-enhanced presentation showcasing highlights, challenges, and lessons learned from the experience. The presentation should be delivered orally, but supported by relevant graphic illustrations, such as diagrams, drawings, and models of project findings, and/or physical artifacts that represent the outcome of the project (i.e., a prototype or 3-D model). Prepare the presentation in a format that could be presented to both a technical and a non-technical audience, as well as for a career and technical student organization (CTSO) competitive event. (TN Reading 1, 3, 7, 9; TN Writing 2, 4, 5, 6, 9)

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for High School: Numbers and Quantity, Algebra, Functions, Geometry, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to
Geographic Information Systems (GIS)

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code(s):	6142
Prerequisite(s):	*Algebra I* (0842, 3102) and *Geometry* (0843, 3108)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other STEM, IT, or Agriculture courses.
Programs of Study and Sequence:	This is an optional elective to support multiple programs of study.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.com Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to your local postsecondary institution.
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 047, 048, 070, 078, 081, 125, 126, 127, 128, 129, 131, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 422, 448, 470, 477, 519, 531, 595, 596, 700, 740, 760
Required Teacher Certifications/Training:	Teachers who have never taught this course MUST attend the training provided by Department of Education or successfully complete Esri Technical certification.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-stem

Course Description

Introduction to Geographic Information Systems is an applied course for students who have already mastered basic computer skills and wish to apply those skills in novel contexts with the use of geographic information systems (GIS) and geospatial technologies. Upon completion of this course, proficient students will develop the ability to reason spatially and analyze relationships among concepts;

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to capture, store, validate, integrate, analyze, and display data related to locations on the Earth; and to create, query, maintain, and modify geospatial datasets. They will learn how GIS is used as a decision-making and data management tool to solve problems in various industries and fields. Furthermore, students will use GIS software to create a spatially accurate map with data retrieved from online or locally available resources. ~~Standards in this course are aligned with the Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is an optional elective credit for students interested in the subject area as a support for their program of study in Agriculture, STEM, or Information Technology. For more information on the benefits and requirements of implementing these programs in full, please visit the career cluster websites:

- Agriculture, Food, & Natural Resources: https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources
- Information Technology: https://tn.gov/education/article/cte-cluster-information-technology
- Science, Technology, Engineering & Mathematics (STEM): https://tn.gov/education/article/cte-cluster-stem

Course Standards

Geographic Information Systems Overview

1) Research the history of mapping, geographic information systems (GIS), global positioning systems (GPS), remote sensing, and other geospatial technologies. Examine how these technologies have evolved, concentrating on their recent migration towards online platforms, and evaluate their influence on present-day society, citing specific textual evidence from news articles and scholarly journals. ~~(TN Reading 1, 2; TN Writing 2)~~

2) Explore several occupations related to the GIS and geospatial technologies fields (such as GIS analyst, GIS technician, cartographer, geospatial information scientist, geospatial information technologist, geographer, engineer, urban and regional planner) and describe the many sources and types of information, such as government, private, and open source data, that these occupations use. Determine how various industries employ different kinds of data to meet their needs. ~~(TN Reading 4, 6, 9)~~

3) Investigate an assortment of skills and education required for GIS and geospatial technology professionals. Write an informative text that identifies the typical educational and certification requirements, working environments, and career opportunities for these occupations. For example, participate in an information-gathering tour of a local organization that uses GIS technology, and report on the roles and responsibilities of GIS professionals on staff, including the kinds of software and equipment they use. ~~(TN Reading 2; TN Writing 2)~~

Geography

4) Distinguish among the characteristics of various types of maps, including but not limited to topographic maps, physical maps, choropleth maps, and heat maps. Explain how they are used to conduct different types of GIS analysis, as well as what types of information they communicate. For example, look at how census data can be displayed as choropleth maps

representing various data fields (e.g., average household income, household size, etc.). Identify key elements of a map, demonstrate how to read a topographic map, and explain how maps can be derived from aerial photography. (TN Reading 4, 9; TN Writing 1; TN Math N-Q)

5) Identify locations within various coordinate systems such as the Geographic Coordinate System, Universal Transverse Mercator (UTM), and the State Plane Coordinate System. Explain the difference between a Cartesian and a geographic coordinate system. Demonstrate the ability to convert latitude and longitude information between degree-minute-second (DMS) and decimal-degree (DD) forms. (TN Reading 4, 7; TN Math N-Q, A-CED)

6) Distinguish among the characteristics of various types of data such as vector data (i.e. points, lines, polygons) and raster data, and explain how they are used to conduct GIS research and analysis. For example, using GIS software, demonstrate how to select layers to create various views of a location or create buffers around vector data features. (TN Reading 4, 9; TN Writing 1; TN Math N-Q, N-VM)

Database Management

7) Find common data sources that can be used to conduct geospatial analysis. Compare and contrast government versus open-source databases for retrieving a range of geospatial data. For example, compare the validity of data retrieved from OpenStreetMap (OSM) with data retrieved from the Census Bureau. (TN Reading 6, 9; TN Writing 4)

8) Apply data entry techniques to enter and manipulate text and data using various software applications (such as spreadsheets, presentations, word processing, and database management systems). For example, create a spreadsheet with coordinate data and upload the data to a GIS. Review and evaluate the input for accuracy, quality, and completeness of documentation. Report the evaluation of the data and justify the conclusions. (TN Reading 4)

9) Understand and demonstrate the effective use of file and folder management techniques for either Windows or Mac environments. For example, demonstrate knowledge of the interoperability between Microsoft Office and Esri products or the use of cloud computing and a GIS. (TN Reading 3)

Software Applications and GIS Analysis

10) Perform a multistep procedure that a GIS technician would follow to build a geospatial database and manipulate the data within a GIS software package. For example, implement a workflow to use GPS equipment to collect data and transfer that data to a GIS. Use the GIS to measure distance, calculate area, edit feature data, and display features and map elements. (TN Reading 3, 4; TN Writing 6, 7, 9; TN Math N-Q, G-GMD, G-MG)

11) Demonstrate how to symbolize, edit, sort, and query data in GIS software, and how to effectively use zooming, identifying, selecting, and panning tools. Practice communicating the procedures to others in a mock-workplace scenario, such as a situation when a geospatial technologist must provide technical support to a telecommunications client. (TN Reading 1, 3; TN Writing 2; TN Math N-Q, G-CO)

12) Analyze spatially-based data to create reports and construct graphic illustrations (such as bar graphs, scatter plots, histograms, and maps) for a technical or lay audience using GIS software and other technologies. Interpret the information assembled in the form of summary and descriptive statistics (such as mean, median, mode, and range), and discuss how the results could be used as decision-making tools in various fields (such as agriculture, health care, community planning, engineering, banking and financial services, transportation, or public safety). (TN Reading 1, 4, 7; TN Writing 6, 8; TN Math S-ID)

13) Simulate the work of a team of GIS technicians charged with producing data layers and maps. Plan and implement a multistep procedure to layout and print maps, including development of map templates. This procedure should include, but is not limited to: defining page margins and parameters for printing a specific size, effectively using required map elements (such as title, author, data sources, legend, north arrow, and scale bar), and creating digital archives of maps. (TN Reading 3; TN Writing 4, 6; TN Math N-Q, G-CO)

14) Develop a research question that will guide an examination and analysis of a geographic trend or phenomenon occurring in society. Write a report to discuss the research findings and represent data in maps and other graphic illustrations (such as bar graphs, scatter plots, histograms). For example, investigate how industrial development affects the population of various animals in a specified area. Develop and strengthen writing through planning, revising, editing, and rewriting the research essay over time. (TN Reading, 1, 7, 9; TN Writing 2, 5, 6, 8, 9)

15) Research an issue affecting the community that can be analyzed using GIS. Define the scope of the problem and develop a research question that will guide a service learning project to address the problem. Using public data such as the American Community Survey, conduct an original analysis of the problem, engaging community members and affected populations, and deliver the results in the form of a poster or multimedia presentation. The presentation should be of academic competition quality and should discuss the problem statement/research question, descriptive information on the community, the methodology used to explore the problem, and a recommended solution justified by GIS analysis. (TN Reading, 1, 4, 7; TN Writing 1, 7; TN Math N-Q, A-CED)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 8, and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.

- ~~TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity, Geometry, Algebra, Statistics and Probability.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, geometric, algebraic, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM Explorers

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	0649
Prerequisite(s):	None
Credit:	N/A
Grade Level:	6
Graduation Requirement:	N/A
Coursework and Sequence:	This is the first course in the *Middle School STEM* sequence of coursework.
Aligned Student Organization(s):	Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	N/A
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	001, 013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 101, 121, 122, 123, 124, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 400, 401, 402, 413, 414, 415, 416, 417, 418, 440, 470, 477, 499
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework

Course Description

STEM Explorers is a fundamental course for middle school students to search for answers to *"What is STEM?"* A student proficient in this course will understand science, technology, engineering, and mathematics (STEM) as a collection of interrelated disciplines, rather than a series of isolated fields. Students will come away from this course with a thorough understanding of how the STEM disciplines

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work together to investigate the world, define problems, and create optimal solutions to benefit society. In this course, students will explore the history of engineering and technology; they will be introduced to the practices of science and engineering; and they will explore various STEM fields to empower them to make an informed decision when selecting a career pathway in high school. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the first course in the *Middle School STEM* sequence of coursework. This program leads to several programs of study in the STEM career cluster in high school. For more information on the benefits and requirements of implementing these programs in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

STEM Overview

1) Drawing on multiple sources (such as the Internet, textbooks, videos, and journals), investigate historical figures and milestones in science, technology, engineering, and mathematics. Create a report over a selected STEM figure or milestone. Explain how this figure or milestone had a lasting influence on at least two of the four STEM fields. ~~(TN Reading 9; TN Writing 2, 4)~~

2) Drawing on multiple sources (such as the internet, textbooks, videos, and journals), research technologies that have benefited society. Create a presentation illustrating society's role in the creation of a chosen technology. Discuss the societal needs that led to the creation of this technology, as well as the benefits resulting from it. Provide examples to support the claim that this technology has been beneficial to society. Relate the specific areas of science, technology, engineering, and math that contributed to the development of this technology. ~~(TN Reading 7; TN Writing 1, 4)~~

Science & Engineering Practices

3) Explain how asking scientific questions can help to define an engineering problem to be solved. Choose a specific question(s) and problem that a scientist or engineer would encounter, then develop a model to illustrate the problem. Provide textual evidence from science and engineering books and websites to justify why the model illustrates the problem. ~~(TN Reading 2; TN Writing 1, 4, 9)~~

Safety

4) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4)~~

5) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures

with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)

STEM Fields Exploration

6) Investigate the following six STEM-intensive career clusters: Manufacturing; STEM; Health Sciences; Information Technology; Architecture and Construction; Agriculture, Food and Natural Resources; and Transportation, Distribution and Logistics. Identify companies and organizations in the state, region, and the school's local community related to each of these clusters. Create an informative poster or presentation that identifies companies in each cluster, the products they produce, and the services they offer. (TN Reading 7; TN Writing 2, 4, 7)

7) Research various occupations in each of the six STEM-intensive career clusters: Manufacturing; STEM; Health Sciences; Information Technology; Architecture and Construction; Agriculture, Food and Natural Resources; and Transportation, Distribution and Logistics. Compose an informative table or chart highlighting at least one occupation in each cluster, to include the following: work activities typically performed; tools and technology used; nature of the work environment; and the knowledge and skills needed for success. (TN Reading 7; TN Writing 2, 4)

Manufacturing Cluster

8) Investigate the field of manufacturing and manufacturing processes. Drawing on technical texts and exemplar designs retrieved from manufacturing websites, design and create a model of a manufacturing process. Demonstrate how the model would be used by a manufacturer to conduct a specific manufacturing process. Write a persuasive essay that argues for the quality and efficiency of the model and the process it simulates/demonstrates. Then, evaluate the model and discuss how it and/or the process can be improved. (TN Reading 7, 9; TN Writing 1, 4, 9)

STEM Cluster

9) Research engineering and scientific texts to understand the engineering design and scientific inquiry processes. Design and create a product that meets specific constraints and criteria using an engineering process that includes the following: identifying the problem; identifying criteria and specifying constraints; brainstorming for possible solutions; researching and generating ideas; exploring alternative solutions; selecting an approach; writing a design proposal, developing a model or prototype; testing and evaluating; refining and improving; creating or making a product; and communicating results. Evaluate and report whether the solution met the original criteria and constraints, as well as what improvements could be made to the solution, including a summary of data. *For example, students design and build a paper airplane that will stay aloft for the longest time. Students record their plane design before building and testing it. Students build and test their plane three times, recording the time aloft in each test. Students make a modification to their plane design. Students should be encouraged to only modify a single variable. Students build and test their modified plane three times as with their original plane. This process may be repeated multiple times. Students should create and present a report of the design, test results, results and conclusions. Teachers may wish to have students use their phones to take pictures of their plane designs and test results.* (TN Reading 3; TN Writing 1, 4)

Health Sciences Cluster

10) Research areas of the health sciences field. Collect, graph, and analyze personal health or forensic-related information. Write a brief explanation that categorizes the data collected and then describes the significance of the data. *For example, students may collect personal health-related information, such as heart rate (resting, vs. standing vs. active), their BMI, flexibility, or their lung capacity, and compare these against government recommendations. Alternatively, students may collect and analyze forensic information, such as hair or fingerprint samples. Students may then analyze and classify the samples. In either of these examples, the class or individuals' data should be graphed using bar or box-and-whisker graphs.* ~~(TN Reading 3, TN Writing 2, 4;TN Math 6.EE, 6.SP)~~

Information Technology Cluster

11) Research the field of information technology (IT) and define a problem that could be solved by an IT professional. Create a presentation that defines the problem and presents a possible solution including some form of information technology. Create a model (could be 3-D, a diagram, website, etc.) to illustrate the problem, the solution, or both. Include an informative evaluation of the model that explains the features and limitations of the model. *For example, students design a webpage that educates the community about an issue, concept, or program. The webpage may include audio, video, graphics, and text. After completing the webpage, have students check the size of the webpage, calculate download time under various download speeds, and determine changes that could be made to improve download time.* ~~(TN Reading 3, 7; TN Writing 2, 4)~~

Architecture & Construction Cluster

12) Research a well-known building, such as the Empire State Building. Incorporate information obtained from the research to inform an original design for a structure meant to serve a specific purpose. Create a scaled drawing of the design as well as a 3-D model, attending to appropriate dimensions and scale. Provide evidence supporting why the design will work to meet the specific purpose. *For example, students design and build a model of a bridge that spans a specific space. Present the size of the bridge across a life-sized ravine and specify the material from which the students may build their model (i.e., balsa wood, bass wood, tooth picks, or soda straws). Test the load capacity of the bridge.* ~~(TN Reading 3, 7; TN Writing 1, 4; TN Math 6.RP)~~

Agriculture, Food & Natural Resources

13) Research a problem related to agriculture, food, and natural resources that could be solved using science, engineering, technology, and/or math. Design and conduct an experiment with a single independent variable that models the selected problem. Collect and analyze the data from the experiment. Create a report on the experiment that includes:
   a. Introduction explaining the principle tested and the methodology used in the test
   b. Data in graphs and/or tables
   c. Explanation of the data analysis
   d. Findings and conclusion from the experiment, as well as a justification to support the conclusion

For example, students design a water filtration experiment. The students test the ability of various materials, such as activated charcoal, a coffee filter, rocks, dirt, or a combination of materials, to clean water via a filtration process. Students should measure the volume, mass, and density; judge color; measure spectroscopy; and/or test the pH of water samples before and after filtration. ~~(TN Reading 3, 7; TN Writing 1, 2, 4; TN Math 6.SP)~~

Transportation, Distribution & Logistics

14) Research a problem relating to transportation, distribution, and logistics that could be solved using science, engineering, technology, and/or math. Design a model of a transportation technology based on specific criteria and constraints. Test the model's performance. Modify single aspects of the model's design and retest the model. Graph and analyze data from the test. Write an explanation based on the data analysis describing how the model could be further modified to optimize the design. Include any reasons why the test may have produced data that does not reflect the actual impact of the change in the test variable. *For example, have students design and build a water bottle rocket. Divide the class into groups and have the various groups each test a different variable such as ballast, nose cone design, fin size, fin shape, water-to-air mixture, and bottle size. After each group presents their findings, assign the students to construct a rocket that will reach the maximum altitude.* ~~(TN Reading 3, 7; TN Writing 1, 4; TN Math 6.RP, 6.SP)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 6-8 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 6-8 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for Middle School.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate mathematical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM Innovators

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	0749
Prerequisite(s):	None
Credit:	N/A
Grade Level:	7
Graduation Requirement:	N/A
Coursework and Sequence:	This is the second course in the *Middle School STEM* sequence of coursework.
Aligned Student Organization(s):	Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	N/A
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	001, 013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 101, 121, 122, 123, 124, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 400, 401, 402, 413, 414, 415, 416, 417, 418, 440, 470, 477
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework

Course Description

STEM Innovators is a fundamental course for middle school students to understand the relationship between STEM and innovation, as well as explore the possibilities of *"What could be?"* Upon completion of this course, proficient students will understand why innovation is important and how it benefits society. Students will learn how innovation requires creativity and leads to new discoveries and technologies that make life better for humans. In this course, students will identify past innovations and

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what inspired their creation. Students will continue learning the practices of science and engineering. This course will reinforce the specific practices of developing and using models; planning and carrying out investigations; and analyzing and interpreting data. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Middle School STEM* sequence of coursework and prepares students for many programs of study in the STEM career cluster in high school. For more information on the benefits and requirements of implementing these programs in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Introduction to Innovation

3) Research great innovators. Create a presentation about selected innovators and their occupations. Discuss what inspired them, how their innovations have affected society, their education and background (Were they engineers or scientists?), and how they used science, technology, engineering, and mathematics to innovate. Examples of great innovators include Alexander Graham Bell (the telephone), Thomas Edison (electricity), Albert Einstein (theory of relativity), Henry Ford (assembly line), Grace Hopper (developed the first compiler for a programming language), Martin Cooper (wireless communications), Bill Gates (Microsoft), Steve Jobs (Apple), Mark Zuckerberg (Facebook), Jack Dorsey (Twitter). ~~(TN Reading 4; TN Writing 2, 4, 9)~~

4) Research and identify skill sets that are important to innovators. Given a specific product, criteria and constraints, apply the innovation skills identified in the research to suggest improvements to the product. Working collaboratively with peers, implement the suggested improvements and defend choices in a presentation to the class. In the presentation, highlight the skill sets that were applied in the process and discuss why they were helpful in improving the product. *For example, students build a wind turbine from a kit and measure the amount of electricity it produces from the wind created by a fan. Students then redesign the size, shape, or number of turbine fins to increase the electrical output by at least 20 percent.* ~~(TN Reading 3; TN Writing 1, 4)~~

5) Select one of the STEM-intensive career clusters and create a timeline of technological developments that helped advance industries associated with that cluster. (The STEM-intensive career clusters are considered to be: Manufacturing; STEM; Health Sciences; Information Technology; Architecture and Construction; Agriculture, Food & Natural Resources; and Transportation, Distribution & Logistics.) Present this timeline as a 3-D model, PowerPoint, Prezi, poster, etc. Include in the presentation how society's needs have affected this technological development. (TN Reading 4; TN Writing 2, 4, 9)

6) Research how a specific product became trademarked or patented, and write a brief blog post citing historical documents and other narratives to tell the story. Detail the process involved as this innovator or group of innovators secured intellectual property rights for the product, discussing any legal, political, or cultural obstacles faced. For example, research the development of the first smartphone and describe the experience with the trademark and/or patenting process. (TN Reading 1, 4; TN Writing 2, 4, 7, 9)

Innovation Process

7) Select and research a personally-used technology that was an improvement over an existing technology. Identify the reasons for the innovation, the approximate date of the innovation, and the process that resulted in the innovation. Compare and contrast the existing technology with the technology it replaced. Present the findings to the class. (TN Reading 4; TN Writing 2, 4, 9)

8) Articulate the concepts of divergent and convergent thinking to classmates. Create a table comparing and contrasting divergent (creativity) thinking and convergent (usually used in engineering) thinking. Research and present an example illustrating the convergent and/or divergent thinking processes involved in a specific innovation. (TN Reading 3; TN Writing 2, 4)

9) Research an existing technology whose purpose is to solve a societal problem, and follow a general innovation process to determine if the technology can be improved upon. The process should include, but is not limited to:
   a. Researching the advantages and disadvantages, including costs and benefits, of an existing technology whose purpose is to solve a societal problem
   b. Presenting the advantages and disadvantages and proposing alternatives and solutions to the disadvantages
   c. Analyzing and comparing advantages and disadvantages of a proposed solution
   Consider any environmental, health, and economic impacts of the proposed solution. Prepare a chart illustrating the trade-offs and impacts of the proposed solution and include it in the presentation. (TN Reading 3, 4; TN Writing 2, 4)

10) Illustrate how the practices of science and engineering relate to the innovation process. This illustration could be in the form of a skit, a PowerPoint, a poster, or other graphic illustration. Science and engineering practices include: Asking questions (for science) and defining problems (for engineering); developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computational thinking; constructing explanations (for science) and designing solutions (for engineering); engaging in argument from evidence; obtaining, evaluating and communicating information. *For example, students create questions that could have led to the development of the iPad.* (TN Reading 3; TN Writing 2, 4)

11) Given a specific product, apply science and engineering practices *(as listed above)* to improve the product in a measurable manner. Design, produce, test, and analyze an improved product that meets specific constraints and criteria. Compose a report that summarizes the test data, evaluates whether the solution meets the original criteria and constraints, discusses and justifies what improvements were made to the original product, and explains what improvements could be made to the solution. *For example, students are shown a model catapult and a demonstration of its launching power. Students then design a new catapult that outperforms the catapults demonstrated in distance or accuracy. Students create a design that specifically shows what feature is modified to improve performance. Students conduct tests of their design, modify their design, and produce a final product.* (TN Reading 3; TN Writing 1, 4)

Fundamental Sketching

12) Identify basic design and sketching principles used in the design stage of the innovation process, including orthographic projection, object lines, hidden lines, dimensioning, and scale. Create a scaled and dimensioned, single or multi-view sketch of a product. *(Note: There are multiple versions of the design process. This standard will address one version.)* (TN Math 7.RP, 7.G)

3-Dimensional Models & Prototypes

13) Research how 3-D printing and rapid prototyping have revolutionized the innovation process, consulting popular news media, engineering journals, and relevant industry magazines. Design a 3-D model of a chosen product using computer-aided drafting or modeling software such as SolidWorks or Google SketchUp, then create a 3-D model of the design. Explain how 3-D printing can simplify the process of making changes to the product. *For example, students make a product with a 3-D printer, if feasible, after designing it. Otherwise, they could use available materials.* (TN Reading 2, 3, 4; TN Math 7.G)

Projects

14) Research the Maker Movement and Maker Faire, exploring associated websites and independent commentary (i.e., in news media, in scholarly magazines) to assess the impact they have had on today's culture of innovation. Develop a proposal to host a Maker Faire or similar exhibition/event in the school. Using research, justify the benefits of hosting such an event, citing the importance of the modern Maker Movement as it relates to fostering innovation. (TN Reading 4; TN Writing 1, 4, 9)

15) Research needs in the community or society in general using the internet, news sources, and/or surveys of individuals outside the classroom. Based on information gathered, apply an innovation process to create a product or technology that meets the need. Create a multimedia presentation that defines the problem or need and illustrates an appropriate method to document the innovation process (such as an innovation portfolio). Use this documentation method to record the process of developing the product or technology that meets the need or solves the problem. Demonstrate visually how the process was applied in the multimedia presentation. *(Example activity: Stage a school junior Maker Faire or technology fair. Have students create, display, and present their products at this event. If possible students can use a 3-D printer to create a prototype or scale model of their product.)* (TN Reading 3, 4; TN Writing 2, 4)

Standards Alignment Notes

*References to other standards include:

- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 6-8 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, 7, 8, 9 and 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 6-8 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for Middle School.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate mathematical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

STEM Designers

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	0849
Prerequisite(s):	None
Credit:	N/A
Grade Level:	8
Graduation Requirement:	N/A
Coursework and Sequence:	This is the third course in the *Middle School STEM* sequence of coursework.
Aligned Student Organization(s):	Technology Student Association (TSA): http://www.tntsa.org Dina Starks, (615) 741-8836, Dina.Starks@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	N/A
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	001, 013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 101, 121, 122, 123, 124, 125, 126, 127, 128, 129, 157, 210, 211, 212, 213, 214, 230, 232, 233, 400, 401, 402, 413, 414, 415, 416, 417, 418, 440, 470, 477
Required Teacher Certifications/Training:	Teachers who have never taught this course must attend training provided by the Department of Education.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework

Course Description

STEM Designers is a fundamental middle school course that trains students to define problems and methodically answer the question, *"What is the solution?"* Upon completion of this course, proficient students understand that engineering design is a process of developing solutions to problems and challenges in order to meet the needs of society. Students continue to apply the practices for science and engineering learned in *STEM Explorers* and *STEM Innovators*; however, *STEM Designers* places more

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emphasis on practices such as using mathematics and computational thinking; designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information. In addition to gaining a deep understanding of the relationship between engineering and design, students who complete this course will learn how both innovation and engineering design result in new technologies that benefit humans. ~~Standards in this course are aligned with Tennessee State Standards in English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Note: Students are expected to use engineering notebooks to document procedures, design ideas, and other notes for all projects throughout the course.

Program of Study Application

This is the third course in the *Middle School STEM* sequence of coursework and prepares students for multiple programs of study in the STEM career cluster. For more information on the benefits and requirements of implementing STEM courses in full, please visit the STEM website at https://tn.gov/education/article/cte-cluster-stem.

Course Standards

Safety

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. ~~(TN Reading 3, 4)~~

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. ~~(TN Reading 3, 4)~~

Introduction to Engineering

3) Research the history of engineering using textbooks, the websites of professional societies, scholarly narratives, and explain how science, technology, and math have influenced its development. Create a timeline of important engineering milestones, noting the influence of science, technology, and math in the timeline. The timeline may be done via PowerPoint, Prezi, poster, or other graphic format. ~~(TN Reading 1; TN Writing 2, 4, 7)~~

4) Research and illustrate the relationship between science, technology, engineering, and math using a flowchart, Venn diagram, or other graphic organizer. Provide an example of a design solution that incorporated at least three of the disciplines and articulate how they each contributed to the design. ~~(TN Reading 1; TN Writing 2, 4)~~

5) Research how engineers in various disciplines (such as civil, mechanical, electrical, chemical, biomedical, computer, agricultural, industrial, and aerospace) benefit society through the

products and solutions they design. Write a paper arguing for the discipline that has benefited society the most. Illustrate the claim with specific products and benefits. (TN Reading 1; TN Writing 1, 4, 7)

Engineering Design Process

6) Evaluate an existing engineering design, such as a local bridge or a famous building, providing evidence from exemplars and design rubrics to justify whether the design meets the specified criteria. Create a presentation explaining how the steps of the design process might have been used to create this feat of engineering, citing historical narratives, published interviews with the architects or engineers involved, and other informational resources. The typical steps of the design process include: identify the problem; identify criteria and specify constraints; brainstorm for possible solutions; research and generate ideas; explore alternative solutions; select an approach; write a design proposal, develop a model or prototype; test and evaluate; refine and improve; create or make a product; and communicate results. (TN Reading 3; TN Writing 1, 2, 4)

7) Practice exploring alternative solutions in the engineering design process by creating two solutions for an engineering problem. Test each solution and record the test data. Analyze the test data to determine the differences in the quality for the solutions. Write a conclusion that that argues which solution is best and explains why. Support the explanation with specific evidence obtained from test results. For example, create a solar vehicle that is designed travel as fast as possible. The two solutions should have a single variable that is changed, for example drive and axle gear ratio, wheel size, or solar panel angle. (TN Reading 1, 3; TN Writing 1, 4, 7, 9; TN Math 8.SP)

8) Use the engineering design process and the practices of science and engineering (see specific practices below) to develop a solution for a given engineering challenge. Chronologically document the entire process in an engineering notebook. The engineering notebook should have bound, dated, and numbered pages. Use permanent ink to document notes. For example, design a balsa or basswood bridge that has the best performance ratio, maximum capacity divided by mass of the bridge. Tests can be done of various basic structure designs before creating a final design. This test data should be included in the engineering notebook. A hand or digital sketch should be made of the design. Pictures can be taken throughout the process and included in the engineering notebook. At minimum, address the following science and engineering practices:
    a. Using mathematics and computational thinking
    b. Designing solutions
    c. Engaging in argument from evidence
    d. Obtaining, evaluating, and communicating information
(TN Reading 3; TN Writing 4)

Fundamental Sketching and Engineering Drawing

9) Present a two-dimensional design idea using freehand sketching, manual drafting, and computer-aided drafting (such as SketchUp or AutoCad). Designs should be made to scale and include dimensions, labels, and notes. At least one of the designs presented should be an orthographic (multi-view) projection. Use basic dimensioning rules and apply understanding of the use of lines (e.g., object, hidden, center) to inform the design. Sketch principle views of a

simple object from the top, bottom, front, back, left side, and right side. For example, create an orthographic projection of a CO_2 dragster or a floor plan for a home. ~~(TN Reading 3, 4, 7; TN Writing 4; TN Math 8.G)~~

10) Present a 3-D design idea using freehand sketching, manual drafting, and computer-aided drafting (such as SketchUp, SolidWorks, or Inventor). Designs should be made to scale and include dimensions, labels, and notes. Use basic dimensioning rules and apply understanding of the use of lines (e.g., object, hidden, center). *For example, convert the 2-D design in the activity in the previous standard into a 3-D design in the 3-D version of the software used to create the 2-D design.*~~(TN Reading 3, 4, 7; TN Writing 4; TN Math 8.G)~~

11) Create a scaled model of a design concept. A digital or manual drafting design should be made of this model prior to building or producing the model. For example, create a digital 3-D design of a product and use a 3-D printer to create a physical model of the design. If a 3-D printer is not available, build a model from materials provided in the class. ~~(TN Reading 3, 4, 7; TN Writing 4; TN Math 8.G)~~

Final Project

12) Work in groups to solve a community or school problem by applying the engineering design process and the practices of science and engineering. Build a prototype, if feasible, and write a technical report detailing the problem, the design process used, and the solution proposed. Include an evaluation of the quality of the solution, and give a presentation to the class. Be able to justify the final design solution with supporting evidence from the process, including graphic representations and visual aids as appropriate. ~~(TN Reading 1, 3, 4, 7, 9; TN Writing 2, 5, 6, 7, 8, 9, 10)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 6-8 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 2, 5, 6, 8, and 10 at the conclusion of the course.~~
- ~~TN Writing: State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 6-8 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.~~
- ~~TN Math: State Standards for Mathematics; Math Standards for Middle School.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be~~

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Collision Repair

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6172
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the first course in the *Automotive Collision Repair* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507, 771
Required Teacher Certifications/Training:	ASE B-3 or ASE B-4 or I-CAR Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Introduction to Collision Repair is a foundational course in the *Automotive Collision Repair* program of study for students interested in learning more about automotive collision repair technician careers. Upon completion of this course, proficient students will be able to identify and explain the basic steps in the collision repair process, emphasizing the tools, equipment, and materials used. They will be able to describe the major parts of an automobile body and safely perform basic procedures in preparing automotive panels for repair, applying body filling, and preparing surfaces for painting. Standards in this course include career investigation of the opportunities in automotive collision repair as well as an

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overview of the history of automobile design and construction. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.*~~ Students completing the *Automotive Collision Repair* program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair. Some tasks are assigned a "High Priority (HP)" designation. NATEF accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Program of Study Application

This is the foundational course in the *Automotive Collision Repair* program of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Safety

For every task in *Introduction to Collision Repair*, the following safety requirement must be strictly enforced:

1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hearing protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle manufacturer's SRS (supplemental restraint system) types, locations, and recommended procedures before inspecting or replacing components. ~~(TN Reading 3, 4)~~
   a. Use and inspect personal protective equipment every time equipment is used.
   b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
   c. Assume responsibilities under HazCom (Hazard Communication) regulations.
   d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   e. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
   f. Utilize MSDSs (material safety data sheets), and identify the health hazards associated with hazardous material.

History of Automobiles

2) Synthesize research from textbooks, automotive magazines, and professional journals to create an annotated timeline or visual graphic illustrating significant time periods in the development of automobile design and construction, emphasizing the changing collision repair methods. Develop a persuasive essay making a claim about the impact of a particular event or time period on current practices in the collision repair industry. ~~(TN Reading 3, 7; TN Writing 1, 4, 7, 9)~~

Career Investigation

3) Cite supporting evidence from multiple career information sources, such as O*NET OnLine, to summarize the essential knowledge and skills required for collision repair technicians. Identify and analyze areas of specialization within the Collision Repair field such as metal technician, structural technician, refinish technician, and detailing technician. Produce a chart or other graphic detailing the aptitudes and training needed for a collision repair technician career. Devise a tentative career plan to reach employment goals. (TN Reading 1, 2, 7, 9; TN Writing 2, 4, 8, 9)

4) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to investigate local and regional occupational opportunities and trends in the field of collision repair. Synthesize collected data to develop a written summary outlining education requirements, job availability, salaries, and benefits. (TN Reading 2, 7; TN Writing 4, 8, 9; TN Math S-ID)

Overview of Collision Repair Operations

5) Research collision repair processes described in textbooks, repair center websites, or by interviewing technicians. Citing research, create and publish a written, oral, or visual presentation describing the major steps involved in the collision repair process including estimating, disassembling, performing repairs, refinishing, reassembling, detailing, and final inspection. Discriminate between the different types of repair work such as metal work, structural repairs, mechanical and electrical repairs, and refinishing. (TN Reading 1, 2, 3, 4; TN Writing 4, 6, 8, 9)

Vehicle Construction

6) Utilize appropriate terminology to classify and describe vehicles based on vehicle size, roof design, drive system type, and engine location. Compare and contrast the major types of body frames (i.e. body-over-frame, unibody, and space frame). Create a visual display with supporting text to describe the major structural parts, sections, and assemblies of each type of body frame. (TN Reading 2, 3, 4, 7; TN Writing 4)

7) Identify and describe the major parts and components which make up an automobile body, analyzing the purpose of and interrelationships among each component and explaining the sequence in which each is put together in assembly. (TN Reading 2, 3, 4, 5)

Tools & Equipment

8) Accurately identify a wide range of hand tools, power tools, and equipment used in the collision repair industry. Hand tools should include wrenches, sockets, screwdrivers, pliers, files, holding tools, punches, chisels, and hammers in metric and/or Society of Automotive Engineers (SAE) sizes where appropriate/. Power tools should include air tools, grinders, polishers, blasters, and spray guns. Equipment should include spray booths, paint drying equipment, straightening systems, and lifts. (TN Reading 2, 3, 4)

9) Assess a variety of situations requiring the use of hand tools, power tools, and equipment. Select the proper tool, critique the readiness of the tool, use the tool to accomplish the desired task, clean the tool, and then return the tool to its proper storage according to correct size and nomenclature. For example, demonstrate the ability to safely use an air ratchet to remove hood hinge bolts. (TN Reading 3; TN Math N-Q)

10) Use physical measurement devices typically employed in collision repair to complete accurate field measurements. Determine the appropriate units and record accurate measurements of lengths, angles, pressure, volume, and other measurements. Tools should include, but are not limited to: fractional rule, metric rule, measuring tape, dial caliper, micrometer, dial indicators, pressure gauges, and mixing cups. (TN Reading 3; TN Math N-Q)

11) Apply mathematics concepts to solve collision repair problems, distinguishing which principles apply to a given automotive problem. Concepts should include, but are not limited to:
    a. Operating with whole numbers, fractions, and decimals. (TN Math N-Q)
    b. Performing conversions between fractions, decimals, and percent. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch. (TN Math N-Q)
    c. Working with units such as feet, inches, meters, centimeters, and millimeters, and determining appropriate units for a given repair task. For example, convert fractions of an inch into millimeters to determine the appropriate size metric wrench to use to loosen a bolt. (TN Math N-Q)
    d. Performing proportionate reasoning to estimate quantities. (TN Math N-Q)

Collision Repair Materials

12) Distinguish between the various types of fasteners commonly used in vehicle construction, such as bolts, nuts, washers, screws, nonthreaded fasteners, and adhesives, by creating a visual display outlining the properties and uses of each type. Define torque and describe the procedures for applying the appropriate torque to tighten bolts. Demonstrate the ability to accurately remove, reinstall, and select the appropriate fastener in a variety of situations. For example, consult torque specifications to determine the torque value for a given size and grade of bolt and perform proper tightening sequences to secure bolts. (TN Reading 2, 4, 5, 7)

13) Compare and contrast the properties and uses of basic materials employed in collision repair processes, such as body fillers, putty, mashing materials, abrasives, sandpapers, primers, paint types, drying and curing materials, and sealers. Describe and demonstrate common procedures used by collision repair centers to clean and properly dispose of materials and supplies. (TN Reading 3, 4, 9)

Preparation of Non-Structural Body Components

14) Gather information from a variety of print and digital sources, such as textbooks, original equipment manufacturer (OEM) manuals, and online instructional materials, as well as firsthand experiences observing a qualified technician on the basic steps necessary to prepare non-structural body components for repair. Write a summary of the steps involved in the process, as if explaining the process to a new automotive collision repair student, and be able to perform each step. (TN Reading 2, 3, 4, 5, 6, 8; TN Writing 2, 4, 7, 9)

a. Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan. HP-I
b. Inspect, remove, label, store, and reinstall exterior trim and moldings. HP-I
c. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. HP-I
d. Soap and water wash entire vehicle; complete pre-repair inspection checklist. HP-I

Metal Finishing and Body Filling of Non-Structural Body Components

15) Read and interpret textbooks, OEM manuals, and other instructional materials to determine the basic steps necessary to properly repair surface irregularities on a damaged body panel. Apply the appropriate tools, equipment, and procedures to safely perform panel repairs. (TN Reading 2, 3, 4)
    a. Remove paint from the damaged area of the body panel. HP-I
    b. Locate and repair surface irregularities on a damaged body panel. HP-I
    c. Heat shrink stretched panel areas to proper contour. HP-I
    d. Identify different types of body fillers. HP-G
    e. Prepare and apply body filler. HP-I
    f. Rough sand body filler to contour; finish sand. HP-I

Surface Preparation for Painting and Refinishing

16) Read and interpret textbooks, OEM manuals, and other instructional materials to determine the basic steps necessary to prepare a surface for painting. Apply the appropriate tools, equipment, and procedures to safely prepare a surface for painting. (TN Reading 2, 3, 4)
    a. Mix primer, primer-surfacer, or primer-sealer. HP-I
    b. Apply primer onto surface of repaired area. HP-I
    c. Block sand area to which primer-surfacer has been applied. HP-I
    d. Dry sand area to which finishing filler has been applied. HP-I
    e. Clean area to be refinished using a final cleaning solution. HP-I

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.

- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Statistics.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- National Automotive Technicians Education Foundation (NATEF) standards for Non-Structural Analysis and Damage Repair (pages 62-65) and Painting and Refinishing (pages 73-77).
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Collision Repair: Non-Structural

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6062
Prerequisite(s):	*Introduction to Collision Repair* (6172)
Credit:	1 – 3 (See Recommended Credit below)
Grade Level:	10 – 12
Graduation Requirements:	This course satisfies up to three credits of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This course may be used as the second, third, or fourth course in the *Automotive Collision Repair* program of study.
Necessary Equipment:	Please visit http://www.natef.org for necessary equipment list.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Automotive Service Excellence (ASE) Student Certification: Non-Structural Analysis/ Repair or I-CAR Non-Structural Technician ProLevel 1
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507, 771
Required Teacher Certifications/Training:	ASE B-3 or ASE B-4 or I-CAR Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Collision Repair: Non-Structural is for students who wish to obtain in-depth knowledge and skills in repair procedures for non-structural repairs in preparation for postsecondary training and careers as collision repair technicians. Upon completion of this course, proficient students will be able to analyze

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non-structural collision damage and write and revise repair plans. Students will read and interpret technical texts to determine, understand, and safely perform appropriate repair techniques and procedures. Standards in this course include preparing vehicles for repair, removing and replacing panels and body components, metal finishing, body filling, removing and replacing moveable glass and hardware, metal welding and cutting, and repair of plastics. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.*~~ Students completing the *Automotive Collision Repair* program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair. Students completing this course will be eligible to take the examination for ASE Professional Certification in Non-Structural Analysis and Damage Repair (B3). Some tasks are assigned a "High Priority (HP)" designation. NATEF accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Program of Study Application

This course may be used as the second, third, or fourth course in the *Automotive Collision Repair* program of study, based on the focus of the program and number of credits to be offered. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Recommended Credits

If all standards in the course are covered, the course is recommended for three credits. If one or two credits are offered the following options are recommended.

1 Credit Option

Content	Standards
Safety	1- all
Preparation	2- all 3- e, f, g
Outer Body Panel Repairs, Replacements, and Adjustments	4- all 5- b
Metal Welding and Cutting	9- f, g, h, 10- a 11- a, b 12- b, c 13- b
Plastics and Adhesives	14- a, b

2 Credit Option

Content	Standards
Safety	1- all
Preparation	2- all 3- all
Outer Body Panel Repairs, Replacements, and Adjustments	4- all 5- all 6- c, g
Metal Finishing and Body Filling	7- a, b, c, f, g, h, i, j
Moveable Glass and Hardware	8- b
Metal Welding and Cutting	9- all 10- all 11- a, b 12- all 13- all
Plastics and Adhesives	14- all

Course Standards

Safety

For every task in *Collision Repair: Non-Structural*, the following safety requirement must be strictly enforced:

1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hearing protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle manufacturer's SRS types, locations, and recommended procedures before inspecting or replacing components. (TN Reading 3, 4)
    a. Use and inspect personal protective equipment every time equipment is used
    b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment
    c. Assume responsibilities under HazCom (Hazard Communication) regulations
    d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures
    e. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor
    f. Utilize MSDSs (material safety data sheets), and identify the health hazards associated with hazardous material

Preparation

2) Read and interpret a damage report and observe damages, synthesizing information from both text and observation to create a basic repair plan for a damaged automobile. Citing resources such as instructional manuals, textbooks, example work orders, and other resources, create a written overview of the steps necessary to repair the vehicle. (TN Reading 1, 2, 3, 4, 6, 9; TN Writing 2, 4, 9)
    a. Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan. HP-I

3) Describe and demonstrate the steps necessary to prepare an automobile for non-structural repair. Synthesize information gathered from textbooks, online resources, and firsthand experiences observing a qualified technician to create a list of tools, equipment, and materials needed for each step of preparation. Write a description of the responsibilities and procedures of the repair technician, emphasizing safety procedures in each of the following. (TN Reading 2, 3, 4, 5, 6, 9; TN Writing 2, 4, 9)
    a. Inspect, remove, label, store, and reinstall exterior trim and moldings. HP-I
    b. Inspect, remove, label, store, and reinstall interior trim and components. HP-I
    c. Inspect, remove, label, store, and reinstall body panels and components that may interfere with or be damaged during repair. HP-I
    d. Inspect, remove, label, store, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair. HP-G

e. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. HP-I
f. Soap and water wash entire vehicle; complete pre-repair inspection checklist. HP-I
g. Prepare damaged area using water-based and solvent-based cleaners. HP-I
h. Remove corrosion protection, undercoatings, sealers, and other protective coatings as necessary to perform repairs.
i. Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair. HP-I

Outer Body Panel Repairs, Replacements, and Adjustments

4) Read and interpret technical information regarding direct and indirect/hidden damage and direction of impact. Examine case studies to create a library of various damages incurred on a range of vehicle types. Hypothesize the direction of impact of each, citing evidence to justify claims. Use the information to investigate and report on the damage incurred in outer body panels of given vehicles. Drawing on research and feedback from instructors and peers, review, edit, and revise repair plans generated in standard 2, using technology where appropriate. (TN Reading 1, 2, 3, 4, 5; TN Writing 2, 4, 5, 6, 7, 9)
   a. Determine the extent of direct and indirect/hidden damage and direction of impact; develop and document a repair plan. HP-I

5) Distinguish among the various panels and components of a vehicle's outer body. Compare and contrast the tools, equipment, and procedures for inspecting, removing, replacing, and aligning each of the following. Summarize the key considerations and procedures an automotive technician should discern when performing the following processes in a written, oral, or visual presentation, citing evidence from resources such as instructional videos, manuals, tutorials, and other resources. Demonstrate the proper steps in inspecting the components of a vehicle's outer body. (TN Reading 1, 2, 3, 4, 5, 8, 9; TN Writing 2, 4, 9)
   a. Inspect, remove and replace bolted, bonded, and welded steel panel or panel assemblies. HP-G
   b. Determine the extent of damage to aluminum body panels; repair or replace. HP-G
   c. Inspect, remove, replace, and align hood, hood hinges, and hood latch.   HP-I
   d. Inspect, remove, replace, and align deck lid, lid hinges, and lid latch. HP-I
   e. Inspect, remove, replace, and align doors, latches, hinges, and related hardware. HP-I
   f. Inspect, remove, replace and align tailgates, hatches, liftgates, and sliding doors. HP-G
   g. Inspect, remove, replace, and align bumper bars, covers, reinforcement, guards, isolators, and mounting hardware. HP-I
   h. Inspect, remove, replace and align fenders, and related panels. HP-I

6) Use the proper tools and procedures to repair outer body panels. (TN Reading 3, 4)
   a. Straighten contours of damaged panels to a suitable condition for body filling or metal finishing using power tools, hand tools, and weld-on pulling attachments. HP-I
   b. Weld damaged or torn steel body panels; repair broken welds. HP-G
   c. Restore corrosion protection. HP-I
   d. Replace door skins. HP-G
   e. Restore sound deadeners and foam materials. HP-G
   f. Perform panel bonding and weld bonding. HP-G
   g. Diagnose and repair water leaks, dust leaks, and wind noise. HP-G
   h. Identify one-time use fasteners. HP-G

Metal Finishing and Body Filling

7) Examine the processes, tools, and materials involved in applying body filling and finishing metal. Read and interpret instructions to prepare materials such as mixing instructions for body filler. Consult a range of resources which outline minor body repair processes for a variety of damage types. Assess the authors' claims and determine the usefulness of each source. Appropriately use the research to recommend and complete the proper repair procedures for given body panel damages. (TN Reading 1, 2, 3, 4, 6, 8, 9; TN Writing 1, 4, 8, 9)
   a. Remove paint from the damaged area of a body panel. HP-I
   b. Locate and repair surface irregularities on a damaged body panel. HP-I
   c. Demonstrate hammer and dolly techniques. HP-I
   d. Heat shrink stretched panel areas to proper contour. HP-I
   e. Cold shrink stretched panel areas to proper contour. HP-I
   f. Prepare and apply body filler. HP-I
   g. Identify different types of body fillers. HP-G
   h. Rough sand body filler to contour; finish sand. HP-I
   i. Determine the proper metal finishing techniques for aluminum. HP-G
   j. Determine proper application of body filler to aluminum. HP-G

Moveable Glass and Hardware

8) Read and interpret technical information to define the structure, purpose, and function of moveable glass and hardware system components and demonstrate appropriate repairs of each. Create a written, oral, or visual presentation describing the proper procedures for each of the following, drawing on information from textbooks, OEM manuals, diagrams, demonstrations, and other instructional narratives. (TN Reading 1, 2, 3, 4, 7, 9; TN Writing 2, 4, 9)
   a. Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls. HP-I
   b. Inspect, adjust, repair, remove, reinstall or replace weather-stripping. HP-G
   c. Inspect, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs. HP-G
   d. Inspect, remove, reinstall, and align convertible top and related mechanisms. HP-G
   e. Initialize electrical components as needed. HP-G

Metal Welding and Cutting

9) Compare and contrast the different tools, procedures, and welding methods used to weld and cut aluminum, high-strength steels, and other steels, noting when substrates are weldable. Create a chart or other visual display describing the tools, tool settings, procedures, and methods for welding in a variety of situations. Perform basic welding and cutting of aluminum and steel.
   a. Identify weldable and non-weldable substrates used in vehicle construction. HP-I
   b. Weld and cut high-strength steel and other steels. HP-I
   c. Weld and cut aluminum. HP-G
   d. Determine the correct GMAW (MIG) welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation. HP-I

e. Set up and adjust the GMAW (MIG) welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the substrate being welded. HP-I

f. Store, handle, and install high-pressure gas cylinders. HP-I

g. Determine work clamp (ground) location and attach. HP-I

h. Use the proper angle of the gun to the joint and direction of gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. HP-I

10) Describe and demonstrate strategies used to prepare vehicle body components for welding. Write persuasively to describe the key procedures, justifying the need for each by citing information gathered from textbooks, online resources, and other resources. (TN Reading 1, 2, 3, 4; TN Writing 1, 4, 9)

a. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. HP-I

b. Protect computers and other electronic control modules during welding procedures. HP-I

c. Clean and prepare the metal to be welded, assure good metal fit-up, apply weld through primer if necessary, clamp or tack as required. HP-I

11) Distinguish among the various types of weld and joint type. Emphasizing proper safety equipment and techniques, implement the appropriate tools, equipment, techniques, and procedures to perform a variety of welds. (TN Reading 2, 3, 4)

a. Determine the joint type (butt weld with backing, lap, etc.) for weld being made. HP-I

b. Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation. HP-I

c. Perform the following welds: continuous, plug, butt weld with and without backing, fillet, etc. HP-I

12) Identify and demonstrate basic inspection and troubleshooting strategies appropriate for evaluating welds. Use the knowledge to remedy the problem. (TN Reading 3)

a. Perform visual and destructive tests on each weld type. HP-I

b. Identify the causes of various welding defects; make necessary adjustments. HP-I

c. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. HP-I

13) Research, explore, and perform a range of procedures used to cut and attach non-structural components, noting when each method is commonly used based on information gathered from textbooks and online resources. (TN Reading 1, 2, 3, 4; TN Writing 2, 9)

a. Identify cutting process for different substrates and locations; perform cutting operation. HP-I

b. Identify different methods of attaching non-structural components (squeeze type resistant spot welds (STRSW), riveting, non-structural adhesive, silicon bronze, etc.). HP-G

Plastics and Adhesives

14) Given damaged plastic components, use resources such as textbooks, OEM manuals, diagrams, and material instructions to identify the nature of the problem and complete appropriate repair. Develop a graphic illustration to identify and describe the types of plastic repair procedures, emphasizing the conditions which require each type of procedure. Select the appropriate repair

procedures and justify the selection with evidence drawn from the resources listed above. ~~(TN Reading 1, 3, 4, 7; TN Writing 1, 4)~~
   a. Identify the types of plastics; determine repairability. HP-I
   b. Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures. HP-I
   c. Repair rigid, semi-rigid, or flexible plastic panels. HP-I
   d. Remove or repair damaged areas from rigid exterior composite panels. HP-G
   e. Replace bonded rigid exterior composite body panels; straighten or align panel supports. HP-G

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry, and Statistics.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- National Automotive Technicians Education Foundation (NATEF) standards for Non-Structural Analysis and Damage Repair (pages 62 – 65).
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Collision Repair: Painting & Refinishing

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6063
Prerequisite(s):	*Introduction to Collision Repair* (6172)*, Collision Repair: Non-Structural (6062) (optional)*
Credit:	1-3 (See Recommended Credit below)
Grade Level:	10-12
Graduation Requirements:	This course satisfies up to three credits of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This course may be used as the second, third, or fourth course in the *Automotive Collision Repair* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Automotive Service Excellence (ASE) Student Certification: Painting and Refinishing or I-CAR Refinish Technician ProLevel 1
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507, 771
Required Teacher Certifications/Training:	ASE B-2 or I-CAR Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Collision Repair: Painting & Refinishing is for students who wish to obtain in-depth knowledge and skills in automotive painting and refinishing procedures in preparation for postsecondary training and careers as collision repair technicians. Upon completion of this course, proficient students will be able to develop, document, and implement refinishing plans for given vehicles. Students will read and interpret technical texts to determine, understand, and safely perform appropriate repair techniques and procedures. Standards in this course include surface preparation; spray gun and related equipment

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operation, paint mixing, matching, and applying; diagnosis and correction of paint defects; and final detailing. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.*~~ Students completing the *Automotive Collision Repair* program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair Students completing this course will be eligible to take the examination for ASE Professional Certification in Painting & Refinishing (B2). Some tasks are assigned a "High Priority (HP)" designation. NATEF accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Program of Study Application

This course may be used as the second, third, or fourth course in the *Automotive Collision Repair* program of study. For programs who want to focus solely on paining and refinishing, this course should follow the introductory course, be offered for two or three credits, and then lead into *Collision Repair: Damage Analysis, Estimating, & Customer Service* as an optional capstone couse. For programs who want to offer a broader approach, this course should follow *Collision Repair: Non-Structural* as the third or fourth level course. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Recommended Credits

If all standards in the course are covered, the course is recommended for three credits. If one or two credits are offered the following options are recommended.

1 Credit Option

Content	Standards
Safety	1- all 2- all
Surface Preparation	3- c 4- f, h, j, k, l, m, n, t, u
Spray Gun and Related Equipment Operation	5- all
Paint Mixing, Matching, and Applying	6- a, m, o

2 Credit Option

Content	Standards
Safety	1- all 2- all
Surface Preparation	3- all 4- a, b, c, d, e, f, h, i, j, k, l, m, n, p, q, r, t, u
Spray Gun and Related Equipment Operation	5- all
Paint Mixing, Matching, and Applying	6- a, b, e, h, l, m, n, o
Final Detail	8- c, d, e

Course Standards

Safety

For every task in *Collision Repair: Painting & Refinishing*, the following safety requirement must be strictly enforced:

1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hearing protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle manufacturer's SRS types, locations, and recommended procedures before inspecting or replacing components. (TN Reading 3, 4)
   a. Use and inspect personal protective equipment every time equipment is used.
   b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
   c. Assume responsibilities under HazCom (Hazard Communication) regulations.
   d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
   e. Maintain a portfolio record of safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
   f. Utilize MSDSs (material safety data sheets), and identify the health hazards associated with hazardous material.

2) Locate, read, and interpret federal, state, and local regulations impacting the painting and refinishing of vehicles. Follow regulations and procedures to work safely around materials and equipment. (TN Reading 2, 3, 4, 6, 9)
   a. Identify and take necessary precautions with hazardous operations and materials according to federal, state, and local regulations. HP-I
   b. Identify safety and personal health hazards according to OSHA guidelines and the "Right to Know Law". HP-I
   c. Inspect spray environment and equipment to ensure compliance with federal, state and local regulations, and for safety and cleanliness hazards. HP-I
   d. Select and use a NIOSH approved air purifying respirator. Inspect condition and ensure fit and operation. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation. HP-I
   e. Select and use a NIOSH approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation. HP-I
   f. Select and use the proper personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application, paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.). HP-I

Surface Preparation

3) Create and publish a plan for refinishing using a total product system. Perform inspections to determine the condition of the vehicle. Examine resources such as instructional manuals, textbooks, case studies, and other resources to determine the considerations and steps to include in the refinishing plan, citing evidence to justify elements of the plan. Consult with the instructor and peers to edit and revise the plan. (TN Reading 1, 2, 3, 4, 9; TN Writing 2, 4, 5, 6, 9)
   a. Inspect, remove, store, and replace exterior trim and components necessary for proper surface preparation. HP-I
   b. Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants. HP-I
   c. Inspect and identify type of finish, surface condition, and film thickness; develop and document a plan for refinishing using a total product system. HP-G

4) Diagram the steps necessary to prepare the surfaces of a vehicle for painting. Synthesize information gathered from textbooks, online resources, and firsthand experiences observing a qualified technician to create a list of tools, equipment, and materials needed for each step of preparation. Create a visual display with supporting text outlining the responsibilities and procedures of the repair technician, noting the appropriate timing of each task. Perform proper procedures to prepare the surface of a vehicle. (TN Reading 2, 3, 4, 5, 6, 7, 9; TN Writing 2, 4, 9)
   a. Strip paint to bare substrate (paint removal). HP-I
   b. Dry or wet sand areas to be refinished. HP-I
   c. Featheredge areas to be refinished. HP-I
   d. Apply suitable metal treatment or primer in accordance with total product systems. HP-I
   e. Mask and protect other areas that will not be refinished. HP-I
   f. Mix primer, primer-surfacer or primer-sealer. HP-I
   g. Identify a complimentary color or shade of undercoat to improve coverage. HP-G
   h. Apply primer onto surface of repaired area. HP-I
   i. Apply two-component finishing filler to minor surface imperfections. HP-I
   j. Block sand area to which primer-surfacer has been applied. HP-I
   k. Dry sand area to which finishing filler has been applied. HP-I
   l. Remove dust from area to be refinished, including cracks or moldings of adjacent areas. HP-I
   m. Clean area to be refinished using a final cleaning solution. HP-I
   n. Remove, with a tack rag, any dust or lint particles from the area to be refinished. HP-I
   o. Apply suitable sealer to the area being refinished. HP-I
   p. Scuff sand to remove nibs or imperfections from a sealer. HP-I
   q. Apply stone chip resistant coating. HP-G
   r. Restore caulking and seam sealers to repaired areas. HP-G
   s. Prepare adjacent panels for blending. HP-I
   t. Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials needed, preparation, and refinishing procedures. HP-I
   u. Identify metal parts to be refinished; determine the materials needed, preparation, and refinishing procedures. HP-I

Spray Gun and Related Equipment Operation

5) Read and interpret instructional manuals and other technical texts and observe demonstrations of qualified technicians to understand and demonstrate the proper procedures involved in operating a spray gun and related equipment. Use these texts to create a training document to instruct a new technician on maintaining and operating spray guns and related equipment. (TN Reading 2, 3, 4, 5; TN Writing 2, 4)
   a. Inspect, clean, and determine condition of spray guns and related equipment (air hoses, regulators, air lines, air source, and spray environment). HP-I
   b. Select spray gun setup (fluid needle, nozzle, and cap) for product being applied. HP-I
   c. Test and adjust spray gun using fluid, air and pattern control valves. HP-I
   d. Demonstrate an understanding of the operation of pressure spray equipment. HP-G

Paint Mixing, Matching, and Applying

6) Identify paint mixing procedures by interpreting technical information such as technical manuals and manufacturer's websites. Differentiate the effects of paint ratios on the color and composition of paint to hypothesize possible outcomes of each ratio. Calculate proper formulations of paint based upon label directions using formulas. Demonstrate in a live setting or in a presentation the ability to follow painting instructions precisely as they pertain to selection, mixing, handling, and application. Demonstrate procedures to apply paint and refinish plastic parts using the appropriate tools, equipment, and materials. (TN Reading 3, 4; TN Math N-Q, A-CED)
   a. Identify color code by manufacturer's vehicle information label. HP-I
   b. Shake, stir, reduce, catalyze/activate, and strain refinish materials. HP-I
   c. Apply finish using appropriate spray techniques (gun arc, angle, distance, travel speed, and spray pattern overlap) for the finish being applied. HP-I
   d. Apply selected product on test or let-down panel; check for color match. HP-I
   e. Apply single stage topcoat. HP-G
   f. Apply basecoat/clearcoat for panel blending and panel refinishing. HP-I
   g. Apply basecoat/clearcoat for overall refinishing. HP-G
   h. Remove nibs or imperfections from basecoat. HP-I
   i. Refinish rigid or semi-rigid plastic parts. HP-G
   j. Refinish flexible plastic parts. HP-I
   k. Apply multi-stage coats for panel blending and overall refinishing. HP-G
   l. Identify and mix paint using a formula. HP-I
   m. Identify poor hiding colors; determine necessary action. HP-G
   n. Tint color using formula to achieve a blendable match. HP-I
   o. Identify alternative color formula to achieve a blendable match. HP-I
   p. Identify the materials, equipment, and preparation differences between solvent and waterborne technologies. HP-G

Paint Defects - Causes and Cures

7) Create a listing of a wide array of paint defects possible including detailed descriptions, causes, and solutions. Compare and contrast the characteristics and solutions of paint defects in a chart or other visual display. Demonstrate troubleshooting strategies appropriate for identifying and evaluating paint defects in given scenarios including consulting technical documents (such as

textbooks and paint manufacturers' websites). Document findings in a technical report, citing evidence to recommend and justify the necessary correction procedures and methods to prevent future occurrences. Perform proper procedures to correct paint defects. (TN Reading 1, 2, 3, 4, 5, 8, 9; TN Writing 1, 4, 9)

a. Identify blistering (raising of the paint surface, air entrapment); determine the cause(s) and correct the condition. HP-G
b. Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition. HP-I
c. Identify the presence of fish-eyes (crater-like openings) in the finish; determine the cause(s) and correct the condition. HP-I
d. Identify lifting; determine the cause(s) and correct the condition. HP-G
e. Identify clouding (mottling and streaking in metallic finishes); determine the cause(s) and correct the condition. HP-I
f. Identify orange peel; determine the cause(s) and correct the condition. HP-I
g. Identify overspray; determine the cause(s) and correct the condition. HP-I
h. Identify solvent popping in freshly painted surface; determine the cause(s) and correct the condition. HP-G
i. Identify sags and runs in paint surface; determine the cause(s) and correct the condition. HP-I
j. Identify sanding marks or sandscratch swelling; determine the cause(s) and correct the condition. HP-I
k. Identify contour mapping/edge mapping while finish is drying; determine the cause(s) and correct the condition. HP-G
l. Identify color difference (off-shade); determine the cause(s) and correct the condition. HP-G
m. Identify tape tracking; determine the cause(s) and correct the condition. HP-G
n. Identify low gloss condition; determine the cause(s) and correct the condition. HP-G
o. Identify poor adhesion; determine the cause(s) and correct the condition. HP-G
p. Identify paint cracking (shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.); determine the cause(s) and correct the condition. HP-G
q. Identify corrosion; determine the cause(s) and correct the condition. HP-G
r. Identify dirt or dust in the paint surface; determine the cause(s) and correct the condition. HP-I
s. Identify water spotting; determine the cause(s) and correct the condition. HP-G
t. Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition. HP-G
u. Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition. HP-G
v. Identify die-back conditions (dulling of the paint film showing haziness); determine the cause(s) and correct the condition. HP-G
w. Identify chalking (oxidation); determine the cause(s) and correct the condition. HP-G
x. Identify bleed-through (staining); determine the cause(s) and correct the condition. HP-G
y. Identify pin-holing; determine the cause(s) and correct the condition. HP-G
z. Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition. HP-I
aa. Identify pigment flotation (color change through film build); determine the cause(s) and correct the condition. HP-G

Final Detail

8) Explain and demonstrate the proper procedures to complete the final detailing for painting and refinishing projects. Create a checklist and guide a beginning technician could use to plan and perform procedures, noting common mistakes to avoid. ~~(TN Reading 2, 3, 4; TN Writing 2, 4)~~
   a. Apply decals, transfers, tapes, woodgrains, pinstripes (painted and taped), etc. HP-G
   b. Sand, buff and polish fresh or existing finish to remove defects as required. HP-I
   c. Clean interior, exterior, and glass. HP-I
   d. Clean body openings (door jambs and edges, etc.). HP-I
   e. Remove overspray. HP-I
   f. Perform vehicle clean-up; complete quality control using a checklist. HP-I

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 7, 8, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Algebra (pages 58-83).~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and algebraic reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- National Automotive Technicians Education Foundation (NATEF) standards for Painting and Refinishing (pages 73-77).
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Collision Repair: Damage Analysis, Estimating, and Customer Service

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6149
Prerequisite(s):	*Collision Repair: Non-Sructural* (6062) and/or *Collision Repair: Painting & Refinishing* (6063)
Credit:	1
Grade Level:	12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This course is the fourth and final course in the *Automotive Collision Repair* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Automotive Service Excellence (ASE) Student Certification: http://www.asestudentcertification.com/
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507, 771
Additional Required Teacher Certifications/Training:	ASE B-3 Industry Certification
Teacher Resources:	http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml

Course Description

Collision Repair: Damage Analysis, Estimating, and Customer Service is the capstone course in the *Automotive Collision Repair* program of study. It is intended to prepare students for careers in the automotive repair industry. Upon completion of this course, a proficient student proficient will be able

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to assess collision damage, estimate repair costs, and work with vehicle owners in a professional setting. Utilizing problem-solving strategies and resources developed in this course, including original equipment manufacturer (OEM) manuals, electronic data, and photo analysis of damaged vehicles, students will be prepared to generate work orders in a variety of collision damage situations. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.*~~ Students completing the *Automotive Collision Repair* program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision. Some tasks are assigned a "High Priority (HP)" designation. Accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Work-Based Learning Framework

Hands-on Experience** activities may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the final course in the *Automotive Collision Repair* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml.

Course Standards

Safety

For every task in *Collision Repair: Damage Analysis, Estimating, and Customer Service*, the following safety requirement must be strictly enforced**:**

1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. ~~(TN Reading 3, 4)~~
    a. Use and inspect personal protective equipment every time equipment is used.
    b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
    c. Assume responsibilities under HazCom (Hazard Communication) regulations.

d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
e. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
f. Utilize MSDSs (material safety data sheets), and identify the health hazards associated with hazardous material.

Damage Analysis

2) Gather information from a variety of print and digital sources (such as OEM manuals and online instructional materials) as well as firsthand experiences observing a qualified technician on preparing a vehicle for damage analysis. Create a flow chart that will show the entire process of analyzing damage and estimating costs. Write an accompanying text that describes how key steps are accomplished, that is, what the technician should do and observe at each step. Steps include but are not limited to the following. (Note: items marked HP-I should be demonstrated by the student.) (TN Reading 3, 7; TN Writing 2, 4, 7)
   a. Position the vehicle for inspection. HP-G
   b. Prepare vehicle for inspection by providing access to damaged areas. HP-G
   c. Analyze damage to determine appropriate methods for overall repairs. HP-I
   d. Determine the direction, point(s) of impact, and extent of direct, indirect, and inertia damage. HP-G
   e. Gather details of the incident/accident necessary to determine the full extent of vehicle damage. HP-G
   f. Identify and record pre-existing damage. HP-I
   g. Identify and record prior repairs. HP-G

3) Accurately complete a summary of damages on a claim form, citing specific evidence to support the need for components, parts, and labor necessary to repair the vehicle. Formulate a list of needed parts necessary to repair the vehicle to OEM standards. Continue the flow chart begun in Standard 2 to identify suspension, electrical, and mechanical elements as well as interior damage. (TN Reading 1, 4, 7; TN Writing 1, 4, 9)
   a. Perform visual inspection of structural components and members. HP-G
   b. Identify structural damage using measuring tools and equipment. HP-I
   c. Perform visual inspection of non-structural components and members. HP-I
   d. Determine parts, components, material type(s) and procedures necessary for a proper repair. HP-I
   e. Identify type and condition of finish; determine if refinishing is required. HP-I
   g. Identify suspension, electrical, and mechanical component physical damage. HP-G
   h. Identify safety systems physical damage. HP-G
   i. Identify interior component damage. HP-I
   j. Identify damage to add-on accessories and modifications. HP-G
   k. Identify single (one time) use components. HP-G

Damage Estimating

4) Compile evidence from the vehicle and owner/operator, including pictures and written summaries, to ascertain damage, determine make and model, and identify VIN information necessary to determine appropriate OEM parts. (TN Reading 1, 3, 4; TN Writing 2, 4, 9)
   a. Determine and record customer/vehicle owner information. HP-I
   b. Identify and record vehicle identification number (VIN) information, including nation of origin, make, model, restraint system, body type, production date, engine type, and assembly plant. HP-I
   c. Identify and record vehicle options, including trim level, paint code, transmission, accessories, and modifications. HP-I
   d. Identify safety systems; determine replacement items. HP-G
   e. Apply appropriate estimating and parts nomenclature (terminology). HP-I
   f. Determine and apply appropriate estimating sequence. HP-I
   g. Utilize estimating guide procedure pages. HP-I

5) Using the created flow chart, the narratives, and photo analysis, ascertain whether parts will be aftermarket, recyclable, rebuilt, or reconditioned. Based on the information gathered, develop a cost analysis of parts and labor value for each operation required. Determine the extent of direct and indirect damage and direction of impact; develop and document a repair plan that includes summary of damage, recommended repairs, costs of parts and labor, and necessary finishing. Review, edit, and revise plan based on peer and instructor feedback. (TN Reading 9; TN Writing 4, 5, 7, 9)
   a. Apply estimating guide footnotes and headnotes as needed. HP-I
   b. Estimate labor value for operations requiring judgment. HP-G
   c. Select appropriate labor value for each operation (structural, non-structural, mechanical, and refinish). HP-I
   d. Select and price OEM parts; verify availability, compatibility, and condition. HP-G
   e. Select and price alternative/optional OEM parts; verify availability, compatibility and condition. HP-G
   f. Select and price aftermarket parts; verify availability, compatibility, and condition. HP-G
   g. Select and price recyclable/used parts; verify availability, compatibility and condition. HP-G
   h. Select and price remanufactured, rebuilt, and reconditioned parts; verify availability, compatibility and condition. HP-G
   i. Determine price and source of necessary sublet operations. HP-G
   j. Determine labor value, prices, charges, allowances, or fees for non-included operations and miscellaneous items. HP-G

6) Consult print and digital resources, such as invoicing templates and OEM parts manuals, to prepare written work orders for documentation of a collision repair service. Synthesize information about the number and cost of parts, and detail the extent of the services involved. Apply quantitative math skills to develop an accurate cost analysis; then compile the work order using a manual template or word processing software. (TN Reading 4; TN Writing 4, 9)
   a. Recognize and apply overlap deductions, included operations, and additions. HP-I
   b. Determine additional material and charges. HP-G
   c. Determine refinishing material and charges. HP-I
   d. Apply math skills to establish charges and totals. HP-I

e. Interpret computer-assisted and manually written estimates; verify the information is current. HP-I
f. Identify procedural differences between computer-assisted systems and manually written estimates. HP-G
g. Identify procedures to restore corrosion protection; establish labor values and material charges. HP-G
h. Determine the cost effectiveness of the repair and determine the approximate vehicle retail and repair value. HP-G
i. Recognize the differences in estimation procedures when using different information provider systems. HP-G
j. Verify accuracy of estimate compared to the actual repair and replacement operations. HP-G

Vehicle Construction and Parts Identification

7) Consult OEM parts manuals and electronic data to determine cost of components and accessories for various makes and models of vehicles. Write explanatory narratives that examine and define the various components, establish the repairability of those components, and integrate the information accurately into the work order. (TN Reading 1, 2, 4; TN Writing 2, 4, 7, 9)
   a. Identify type of vehicle construction (space frame, unibody, body-over-frame). HP-G
   b. Recognize the different damage characteristics of space frame, unibody, and body-over-frame vehicles. HP-G
   c. Identify impact energy absorbing components. HP-G
   d. Identify steel types; determine repairability. HP-G
   e. Identify aluminum/magnesium components; determine repairability. HP-G
   f. Identify plastic/composite components; determine repairability. HP-G
   g. Identify vehicle glass components and repair/replacement procedures. HP-G
   h. Identify add-on accessories. HP-G

Customer Relations and Sales Skills

8) Interact respectfully with individuals involved in various aspects of customer service, including OEM representatives, customers/clients, insurance representatives, and suppliers. Resolve conflicts and differences to maintain a smooth workflow. Individually craft written scenarios narrating a challenging customer interaction and use the scenarios to practice effective communication techniques in a role-play. Research negotiation skills and apply them to workplace scenarios. (TN Reading 2, 3; TN Writing 2, 4, 7)
   a. Acknowledge and/or greet customer/client. HP-I
   b. Listen to customer/client; collect information and identify customer's/client's concerns, needs, and expectations. HP-I
   c. Establish cooperative attitude with customer/client. HP-I
   d. Identify yourself to customer/client; offer assistance. HP-I
   e. Deal with angry customer/client. HP-I
   f. Identify customer/client preferred communication method; follow up to keep customer/client informed about parts and the repair process. HP-G
   g. Recognize basic claims handling procedures; explain to customer/client. HP-G
   h. Project positive attitude and professional appearance. HP-I

    i.   Provide and review warranty information. HP-I
    j.   Provide and review technical and consumer protection information. HP-G
    k.   Estimate and explain duration of out-of-service time. HP-G
    l.   Apply negotiation skills to obtain a mutual agreement. HP-G
    m.   Interpret and explain manual or computer-assisted estimate to customer/client. HP-I

Hands-on Experience**

Option I: Internship

9) Participate in a work-based learning internship at a licensed collision repair business to develop, practice, and demonstrate skills outlined in standards above. Internship should follow current Tennessee work-based learning guidelines and/or AYES internship guidelines as appropriate.

10) Create and continually update a personal journal to document internship activities. Draw connections between the experience and course content, thoughtfully reflecting on:
    a.   Acquired leadership skills
    b.   Problem-solving techniques and decision-making skills
    c.   Team member participation in a learning environment
    d.   Personal career development
    e.   Opportunities for industry certifications
    (TN Writing 2, 4)

11) Upon conclusion of the internship, write an informational essay summarizing the internship experience and next steps for personal and professional growth. Produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the internship. (TN Writing 2, 4, 6)

Option II: Portfolio

12) Create a portfolio, or similar collection of work, offering evidence to illustrate mastery of skills and knowledge as outlined in the standards above. The portfolio should reflect thoughtful assessment and evaluation of the student's progression of work involving the estimation of damage to a vehicle and adherence to Materials Safety Data Sheets (MSDS). The following documents will reside in the student's electronic career portfolio:
    a.   Personal code of professional ethics
    b.   Career and professional growth plan
    c.   List of responsibilities undertaken throughout the course
    d.   Examples of visual materials developed and used during the course (such as graphics, presentation slides, videos, demonstrations)
    e.   Description of technology used, with examples if appropriate
    f.   Periodic journal entries reflecting on tasks and activities
    g.   Feedback from instructor based on observations
    (TN Reading 7; TN Writing 4)

** Although a hands-on experience in work-based learning (WBL) is the most ideal, it is recognized that not all students will be able to be placed in a working collision establishment. While the WBL experience is encouraged, the portfolio option can be used in place of, or to supplement, an internship experience.

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5 and 10 at the conclusion of the course.~~
- National Automotive Technicians Education Foundation (NATEF) standards for Damage Analysis, Estimating and Customer Service (pages 78-81).
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Aerospace

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6068
Prerequisite(s):	None
Credit:	1
Grade Level:	9-10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the first course in the *Aviation Flight* and *Aviation Maintenance* programs of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	512, 579, 594, 773, 774
Required Teacher Certifications/Training:	FAA Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Introduction to Aerospace is a comprehensive foundational course for students interested in pursuing careers in aviation. This course covers the basic principles governing flight and the regulation of flight that every aviation professional must know regardless of his or her occupation—as a pilot or an engineer, a salesperson or a specialist, a mechanic or a statistician. In addition to acquiring foundational knowledge of safety procedures and industry regulations, students will also gain essential understanding

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of aircraft structures, the flight environment, basic procedures, and navigation. Upon completion of this course, proficient students will be prepared for further study in advanced *Aviation Flight* and/or *Aviation Maintenance* courses. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the foundational course in the *Aviation Flight* and *Aviation Maintenance* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Aviation Safety

1) The number one priority as a pilot is to maintain the safety of flight. Citing course materials such as textbooks and published guidelines including the Federal Aviation Regulations (FARs), identify the basic safety issues a pilot must be aware of before, during, and after each flight, including but not limited to: pilot's mental and physical condition, collision avoidance, weather conditions, maintaining minimum safe altitudes, visual scanning, right-of-way rules, flight over hazardous terrain, positive exchange of flight controls, and operating within the Federal Aviation Regulations (FARs). ~~(TN Reading 1, 2)~~

2) Citing appropriate textual evidence, identify the basic safety issues relating to the aircraft, including but not limited to: aircraft airworthiness, taxiing in wind, operating within the aircraft's approved weight and balance, and airspeed limitations. ~~(TN Reading 1, 2)~~

Careers in Aviation

3) Citing labor and workforce data from public sources such as the United States Bureau of Labor Statistics, research the wide range of career pathways available in aviation today. Create a graphic illustration of major occupations within each pathway, including but not limited to: pilots, airframe and powerplant mechanics (A&P), aeromechanical engineers, aircraft salespersons, airport operators, airline statisticians, air traffic controllers (ATC), and flight service specialists (FSS). ~~(TN Reading 1, 2, 3, 7, 9; TN Writing 2, 4, 8, 9)~~

4) Citing supporting evidence from textbooks, industry magazines, and professional journals, summarize the essential knowledge and skills required for careers in aviation, and describe important aptitudes for success in these careers, such as mechanical, verbal, scientific, manipulative, numerical, administrative, social, and artistic. Complete one or more career aptitude surveys, analyze the results, and discuss how they might inform career decisions in various aviation pathways. ~~(TN Reading 1, 2, 3, 7, 9; TN Writing 2, 4, 8, 9)~~

5) Investigate regulatory agencies, governing bodies, and professional organizations related to the aviation industry, such as the Federal Aviation Administration (FAA), National Transportation Safety Board (NTSB), and National Aeronautics and Space Administration (NASA). Gather

information from their websites and available publications to produce a coherent explanation of their functions, jurisdictions, and importance within the industry. (TN Reading 2, 9)

History of Aviation

6) Synthesize course readings to create an illustrated timeline of historical milestones in the development of flight. Describe the major obstacles that were overcome to achieve controlled, sustained, and powered heavier-than-air flight. (TN Reading 2, 9)

7) Research major contributors to the field of aviation, including scientists, inventors, pilots, and other historical figures, and determine what each person contributed. Discuss their impact on both the development of flight as well as the industry as a whole. (TN Reading 2)

Aircraft Structures

8) Explain the specific functions of various aircraft structures. For example, be able to understand and communicate the purpose for the aircraft's wings, tail, cabin, and other structures. Incorporate relevant design and mathematics concepts as approriate when explaining how specific aircraft structures function. For example, relate how the design of an aircraft's wings leverage the principles of aerodynamics. (TN Reading 4; TN Math N-Q)

Aircraft Overview

9) Draw on aviation handbooks and other course materials to outline the specific functions of each aircraft's flight control. Describe the purpose of the aircraft's ailerons, elevators, rudder, and flaps, and explain the effect that each of these controls has on the aircraft's controllability. (TN Reading 1, 4)

10) Draw on aviation handbooks and other course materials to describe in a verbal or written format how a typical reciprocating engine is used on a general aviation aircraft. Compare and contrast the advantages and disadvantages of a reciprocating engine versus a turbine engine on a training aircraft. (TN Reading 1, 9; TN Writing 2)

11) In a graphic illustration such as an annotated diagram or electronic presentation, explain the typical application and operation of the basic electrical system, including but not limited to:
    a. Battery
    b. Alternator / Generator
    c. Circuit Breakers
    d. Master Switch(es)
    (TN Reading 1; TN Writing 2)

12) Explain how fuel systems operate on a typical aircraft, and cite specific dangers and associated precautions that aircraft personnel should take when inspecting, filling, and draining fuel systems. Given a scenario or diagram assigned by the instructor, demonstrate the ability to identify and describe the characteristics of the fuel system, including but not limited to:
    a. Fuel tanks
    b. Fuel selector valves
    c. Fuel filters and drains

13) Explain the typical application and operation of the basic ignition system, including but not limited to:
    a. Magnetos
    b. Spark plug wires
    c. Spark plugs
    (TN Reading 1, 3)

14) Explain the typical application and operation of the basic flight instruments, including but not limited to:
    a. Airspeed Indicator
    b. Attitude Indicator
    c. Altimeter
    d. Turn Coordinator
    e. Directional Indicator
    f. Vertical Speed Indicator
    (TN Reading 1, 3)

15) Explain the typical application and operation of the basic engine instruments, including but not limited to:
    a. Oil Pressure Gauge
    b. Oil Temperature Gauge
    c. Cylinder Head Gauge
    (TN Reading 1, 3)

16) Explain the typical application and operation of the basic communication and navigation radios and instrumentation, including but not limited to:
    a. Comm # 1
    b. Comm # 2
    c. Nav # 1
    d. Nav # 2
    (TN Reading 1, 3)

Flight Environment

17) Research and develop illustrative models that compare and contrast characteristics of the two basic types of airspace:
    a. Controlled
    b. Uncontrolled
    (TN Reading 1)

18) Consult FAA guidelines to synthesize understanding of air traffic control (ATC) procedures related to visual flight rules (VFR) and instrument flight rules (IFR) operations. Explain the circumstances and conditions of operation regarding:
    a. Airport operations
    b. Local area procedures
    (TN Reading 1, 2)

19) Cite textual evidence from course materials and industry guidelines to explain the importance of meteorological knowledge among aviation professionals. Outline key concepts and terminology for the following:
   a. Basic weather theory
   b. VFR Minimums
   c. IFR Minimums
   (TN Reading 1, 4)

Basic Procedures

20) Under normal conditions, determine adequate benchmarks surrounding the basic aspects of pre-flight, such as:
   a. Pilot's mental and physical health
   b. Airworthiness of aircraft
   c. Weather
   d. Weight and balance
   e. Fuel requirements
   f. Departure and destination airport conditions
   Accurately assess basic situations and conditions in order to make a go/no go decision. (TN Reading 3)

21) Explain and demonstrate in a mock situation or drill (including but not necessarily involving a digital flight simulator) the following basic procedures:
   a. Pre-flight inspection
   b. Starting the engine
   c. Taxiing technique(s)
   d. Takeoffs
   e. Fundamentals of flight
   f. Airport traffic patterns
   g. Wake turbulence
   h. Collision avoidance techniques
   i. Landings
   (TN Reading 3)

22) Under normal conditions, determine adequate benchmarks surrounding the basic aspects of in-flight actions, such as:
   a. Changes in pilot's mental and physical health
   b. Actual wind and weather conditions
   c. Fuel reserve
   d. Destination and alternate airport conditions
   Accurately assess current conditions in order to evaluate a decision to return to departure airport, land at an enroute airport, or continue to destination. (TN Reading 3)

23) Under normal conditions, determine adequate benchmarks surrounding the basic aspects of post-flight actions, such as:
   a. Post flight aircraft inspection to determine airworthiness of aircraft
   b. Evaluation of forecast versus actual weather encountered
   c. Comparison of estimated fuel requirements versus actual fuel consumption

Accurately assess basic situations and conditions experienced in order to make better future go/no go decisions. (TN Reading 3)

Basic Navigation

24) Explain how basic Pilotage and Dead Reckoning (DR) techniques work, and recognize when they are appropriate. Describe how pilots use such techniques in order to fly from one point or location to another , drawing on textbooks and other course materials to provide accurate analyses of different flight situations. (TN Reading 1, 2, 4)

Judgment Training

25) Explore techniques for improving pilot judgment and decision-making skills. Develop an original mock scenario in which a pilot must react to an in-flight complication or malfunction. Outline a strategy or how-to guide for remaining calm under pressure, maintaining lines of communication, and making sound decisions. (TN Reading 3, TN Writing 2, 4)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, 9 and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 9 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Aviation I: Principles of Flight

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6070
Prerequisite(s):	*Introduction to Aerospace* (6068)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the second course in the *Aviation Flight* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	594, 774
Required Teacher Certifications/Training:	FAA Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Aviation I: Principles of Flight builds on the fundamental knowledge and skills learned in *Introduction to Aerospace* while teaching students the essential competencies needed for flight under normal conditions. Upon completion of this course, proficient students will be able to apply knowledge, skills, and procedures in a variety of simulated flight environments. Moreover, students who complete this course will have the opportunity to move on to advanced study in *Aviation II: Advanced Flight*, where

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they will continue to prepare for the FAA Private Pilot written exam. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Aviation Flight* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Safety

1) Gather information from a variety of print and digital sources (such as textbooks, aviation magazines, publications, and industry websites) and write a report based on what the aviation industry is doing to enhance aviation safety. Discuss takeaways to incorporate into future decision making and thought processes that would help in preparation to be a safer pilot or mechanic. ~~(TN Reading 7, 9; TN Writing 4, 8, 9)~~

2) Gather information from a variety of print and digital sources (such as textbooks and online industry publications) on the National Transportation Safety Board (NTSB), its purpose, and how the organization performs its duties. Explain how aviation safety is enhanced by NTSB investigations of aircraft accidents. Read and evaluate at least one aviation NTSB accident report and share with the class the NTSB findings, probable causes of the accident, and any NTSB recommendations based on their findings. Students should personalize what they learned from their research to devise strategies for being a safer pilot or mechanic based on what they learned. ~~(TN Reading 7, 9; TN Writing 4, 8, 9)~~

Careers

3) Research collegiate websites and affiliated publications to create a list of postsecondary educational opportunities that prepare students for careers in aviation. Evaluate personal career goals and desires, then determine which opportunity would provide the best preparation for the desired career. Develop a timeline detailing the postsecondary path that will lead to career goals. ~~(TN Reading 9; TN Writing 4)~~

Aerodynamics

4) Research industry manuals and course materials to explain the interrelationships among aerodynamics forces that affect an aircraft on the ground and in flight. Aerodynamic forces include, but are not limited to: ground effect, torque and P-factor, load factor, and aircraft stability. In addition, be able to explain the effects of frost, the significance of angle of attack as it relates to stalls and spins, and how load factors are affected by airplane turns. ~~(TN Reading 2, 4, 9)~~

Aircraft Systems

5) Describe the characteristics and functions of an airplane's aileron, elevator, and rudder, including the trim system if appropriate, citing technical manuals and industry guidelines. Detail the varying effects of changes in airspeed, density altitude, frost, snow, or ice on each of these functions. Illustrate the operation of aircraft slats, spoilers, speed brakes, and thrust reversers. (TN Reading 2, 3, 4)

6) Compare and contrast the characteristics and operating principles of both a normally aspirated and turbocharged aircraft reciprocating engine, and relate the advantages and disadvantages of each. Explain how a turbine engine operates, including the different sections within the engine, and relate the advantages and disadvantages between a turbo jet, turbo fan, and turbo prop engine. (TN Reading 3, 4)

7) Draw on technical manuals and manufacturers' guidelines to describe the characteristics and chief functions of the following aircraft systems or instrumentation systems: pitot-static system, vacuum system, flight gyros, navigation radios (such as VOR, ADF, and GPS), and aircraft communications radios. In the context of a specific aircraft, explain the advantages and disadvantages of a glass cockpit versus steam gauges. (TN Reading 3, 4)

8) Deliver an oral presentation or guided explanation of the fuel system in a typical training aircraft, highlighting at minimum the following elements: fuel tanks, fuel selector valve, fuel drains, fuel pump(s), carburetor, and fuel injected systems. Distinguish between different types of aviation fuels by sight, color, and/or smell, and determine which type of fuel would be acceptable to use in a reciprocating and/or turbine aircraft engine. (TN Reading 3, 4)

9) Deliver an oral presentation or guided explanation of the electrical system in a typical training aircraft, highlighting at minimum the following elements: battery, alternator/generator, circuit breakers (CBs), and 12-volt and 24-volt systems. (TN Reading 3, 4)

10) Describe how a retractable landing gear system operates in a typical training aircraft, citing aircraft handbooks and other manuals for illustration during normal operation procedures as well as emergency operation procedures. Describe or illustrate the differences between pump versus hydraulic pump systems. (TN Reading 1, 2, 3)

11) Research studies on the effectiveness of anti-skid brake systems. Craft an original argument comparing the advantages and disadvantages of these systems, providing a precise explanation of how they operate and whether they conform to industry safety regulations. Share findings in a written or oral format. (TN Reading 7, 8, 9; TN Writing 1)

Flight Environment
Note: The following standards can be used to meet TN Writing Standard 2 when specifically incorporating a writing assignment in which students write to inform or explain a technical process, concept, or procedure.

12) Gather information from a variety of print and digital sources (such as textbooks, aviation magazines, publications, and industry websites) to synthesize concepts related to the formation of weather, convective currents, fronts, and associated meteorological dangers. Discuss the

explicit dangers, causes, and effects of thunderstorms; discuss airframe and carburetor icing; mountain waves; wind shear; and temperature/dew point. Describe the factors involved in the formation and dissipation of fog, temperature inversions, and clouds. Apply mathematics concepts to determine the stability or instability of an air mass. (TN Reading 2, 9; TN Math N-Q)

13) Outline the restrictions associated with each classification of airspace: Class A, B, C, D, G, Airport Advisory Areas, prohibited or restricted airspace, alert areas, warning areas, and MOCAs. Articulate what relevant laws and regulations govern and apply to airspaces as set forth by the Federal Aviation Regulations. (TN Reading 2, 9)

14) Describe the functions of and explain the differences between each of the following aspects of the flight environment: ATIS, AWOS, Clearance Delivery, Ground Controls, Towers, Approach/Departure Controls, Terminal Radar Programs, Air Traffic Centers (ATC), and Flight Service Stations (FSS). Demonstrate different ways to obtain a weather briefing while on the ground (phone call to FSS, internet, TV, etc.), and explain what a pilot should do to get an updated weather briefing while airborne (FSS, Flight Watch, ATC, XM Weather, etc.). (TN Reading 3, 4)

15) Analyze the following texts, synthesize the information found, and demonstrate the ability to retrieve the correct information in a timely fashion to aid in aviation decision making: Aviation Routine Weather Report (METAR)s, Pilot Weather Reports (PIREP)s, Aviation Area Forecast, Terminal Aerodrome Forecast (TAF)s, Weather Depiction Charts, Radar Summary Charts and Radar Weather Reports, En route Flight Advisory Service (EFAS), Wind and Temperature Aloft Forecasts (FB), Significant Weather Prognostic Charts, AIRMETs and SIGMETs. Given a scenario designed by the instructor, make the appropriate go/no go decision based on the information retrieved. (TN Reading 1, 2, 3, 4, 5, 7, 8, 9)

Complex and Abnormal Procedures
Note: The following standards may require flight simulation equipment or training within another simulated environment in order to fully meet the range of activities outlined below.

16) Demonstrate understanding of various complex and abnormal procedures and be able to accurately perform the correct procedures given a particular set of conditions, including but not limited to procedures relating to stalls and/or spins recovery, engine failures, engine fires, abnormal combustion, carburetor icing, loss of oil pressure, low oil pressure, high oil and/or CHT temperature(s), aircraft wake turbulence, deteriorating weather conditions, low fuel situations, and medical issues with pilot and/or passengers. (TN Reading 3)

17) Synthesize guidelines from piloting manuals to explain and demonstrate the operation of a constant speed propeller system, compass turning, correction of acceleration/deceleration errors, correction of altimeter errors, proper use of EGT for accurate leaning purposes, and navigation at different types of altitudes. (TN Reading 2, 3, 4)

18) Explain the terminology, outline basic procedures, and demonstrate the ability to perform procedures related to the following:
   a. Visual Approach Slope Indicators (VASI)
   b. Runway markings
   c. Taxiway and destination signs

d. Beacons and taxiway lights
e. ATC traffic advisories
f. ATC light signals
g. ELT's and VHF/DR steers
h. Land and Hold Short Operations (LAHSO)
i. Flying rectangular courses
j. Flying S-turns across a road

(TN Reading 3, 4)

Communications

19) Role-play the protocol required for both air and ground communications. Communications include normal, abnormal, and emergency situations for the following: departing and arriving at non-controlled airports, departing and arriving at controlled airports, communicating with ATC, and requesting and receiving enroute weather from a Flight Service Station or Flight Watch. Explain each ATC light signal and the significance to the pilot. (TN Reading 3, 4)

20) Role-play use of the correct aviation terminology and radio phraseology required during all aspects of a flight, including but not limited to: receiving the current aircraft weather before starting the engine(s); calling ground control for a taxi clearance before taxiing, or advising traffic on the common traffic advisory frequency; and requesting a takeoff/landing clearance. (TN Reading 3, 4)

Physiology, Aeronautical Decision Making (ADM), and Judgment Training

21) Demonstrate understanding of, recognize the symptoms of, and react properly to the following aeromedical factors affecting a pilot, including but not limited to: pressure effects, ear and sinus blockage, toothaches, stress, fatigue, noise, alcohol/drugs, hypoxia, hyperventilation, spatial disorientation, vision issues, and carbon monoxide poisoning. Perform a preflight self-inspection and determine airworthiness based on an appropriate rubric provided by the instructor. (TN Reading 3)

22) The goal of developing the skills required to make wise decisions is to increase safety. Develop a clear and systematic ADM system, or outline a plan to manage the human factors which may affect whether a safe or unsafe outcome occurs in the course of flight. Consult recommendations and best practices endorsed by industry to guide the process. Students should develop a flow chart showing the proper steps and factors involved in making effective and timely decisions, including at minimum protocols for assessing pilot-in-command responsibility, communication, workload management, resource use, and situational awareness. (TN Reading 9; TN Writing 4, 9)

23) Build upon principles previously learned and continue to refine one's thought process relating to judgment training. Based on experiences in this course, compose an essay demonstrating a pilot's good judgment(s) relating to a challenging in-flight situation. (TN Writing 4)

Navigation

24) Accurately describe how to use the communication radios, navigation radios, ADF, DME, transponder, ELT, and autopilot (if aircraft so equipped), and be able to list any limitations as to their useful range. Explain the process around confirming that each radio or equipment is in working condition per the manufacture's operating manual or normal operation procedures. Student will also understand and explain the following transponder codes (1200, 7700, 7600, and 7500) and be able to list what each code communicates to ATC, as well as the function of Mode C and "Ident" button. ~~(TN Reading 3, 4)~~

25) Accurately express how the basic GPS system works in an aircraft, and cite specific principles of operation to determine the advantages and disadvantages of GPS navigation over the VOR and NDB systems. ~~(TN Reading 9)~~

26) Clearly explain how to use sectional and world aeronautical charts during a cross country flight to determine aircraft's position by use of pilotage and dead reckoning (DR). Given an appropriate scenario provided by the instructor, demonstrate proficiency in the use of lines of longitude and latitude to determine checkpoints or landmarks on a sectional and/or world aeronautical chart, and be able to input that information into a GPS for navigation purposes. Analyze the information retrieved to determine the necessary radio frequencies listed, the different types of airspace, and the altitudes of that airspace by using a sectional and/or world aeronautical chart. ~~(TN Reading 3, 4, 7, 8; TN Math N-Q)~~

27) Gather information from a variety of publications such as FAA Advisory Circulars, Airport/Facility Directories, and Notices to Airmen Publications (NTAP) and be able to communicate that information to other crew members in order to successfully plan and fly to a desired cross-country destination safely. ~~(TN Reading 9; TN Writing 4)~~

28) Understand and be able to clearly explain how to use a VOR for navigation purposes, determine an aircraft's position, and determine the radial distance from a VORTAC facility. Additionally, determine when an aircraft crosses over a VOR station. Apply this knowledge to use a VOT and/or a VOR in the process of determining whether the VOR is within the accuracy requirements in the FARs. ~~(TN Reading 3, 4; TN Math N-Q)~~

Predicting Aircraft Performance and Weight & Balance

29) Describe the effects of density altitude on aircraft performance, drawing on technical aids and course materials. Given a particular set of conditions, determine and accurately perform density altitude computations. ~~(TN Reading 9; TN Math N-Q)~~

30) Consult aircraft manuals, tables, and charts to accurately determine aircraft cruise power settings. Explain in a mock communications scenario with a superior how different cruise power settings were determined, citing the advantages and disadvantages of each. ~~(TN Reading 9; TN Math N-Q)~~

31) Consult aircraft manuals, tables, and charts to accurately determine the headwind/tailwind and crosswind components. Report on how each component was determined; based on the analysis,

evaluate if the crosswind component is within the manufacturer's approved or demonstrated crosswind component. (TN Reading 9; TN Math N-Q)

32) Consult aircraft manuals, tables, and charts to accurately determine the required takeoff run distance based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the takeoff distance was determined. (TN Reading 9; TN Math N-Q)

33) Consult aircraft manuals, tables, and charts to accurately determine the required takeoff distance to clear a fifty-foot obstacle based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the takeoff distance was determined. (TN Reading 9; TN Math N-Q)

34) Consult aircraft manuals, tables, and charts to accurately determine the required landing roll distance based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the landing distance was determined. (TN Reading 9; TN Math N-Q)

35) Consult aircraft manuals, tables, and charts to accurately determine the required landing distance to clear a fifty-foot obstacle based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the landing distance was determined. (TN Reading 9; TN Math N-Q)

36) Consult aircraft manuals, tables, and charts to accurately confirm that the projected weight is within the manufacturer's approved maximum takeoff weight and that the center of gravity is within the manufacturer's approved takeoff CG envelope. Citing examples drawn from textbooks and manuals, explain weight and balance definitions and relate how to reduce the payload as needed to bring the aircraft within the manufacturer's approved maximum takeoff weight. Additionally, determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved takeoff CG envelope. (TN Reading 3, 4, 9; TN Math N-Q)

37) Consult aircraft manuals, tables, and charts to accurately confirm that the projected weight is within the manufacturer's approved maximum landing weight and that the center of gravity is within the manufacturer's approved landing CG envelope. Citing examples drawn from textbooks and manuals, demonstrate how to reduce the payload before takeoff as needed to bring the aircraft within the manufacturer's approved maximum landing weight. Additionally, determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved landing CG envelope. (TN Reading 3, 4, 9; TN Math N-Q)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).

- o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6 and 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - o Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 7, and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity.
  - o Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Aviation II: Advanced Flight

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6148
Prerequisite(s):	*Aviation I: Principles of Flight* (6070)
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the third and final course in the *Aviation Flight* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	Private Pilot Ground Test
Dual Credit or Dual Enrollment Opportunities:	There are currently dual enrollment opportunities with specific universities, including Middle Tennessee State University.
Teacher Endorsement(s):	594, 774
Required Teacher Certifications/Training:	FAA Industry Certification
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Aviation II: Advanced Flight is the capstone course in the *Aviation Flight* program of study intended to prepare students for careers in aviation. While continuing to build upon the knowledge, skills, and competencies acquired in *Introduction to Aerospace* and *Aviation I*, students in *Aviation II* will receive rigorous instruction in preparation to take the Federal Aviation Administration (FAA) Private Pilot written exam. This course goes beyond the mastery of procedures under normal conditions learned in

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Aviation I: Principles of Flight and introduces students to the troubleshooting and diagnostic techniques used by pilots and other aircraft personnel to assess and correct for malfunctions, make adjustments in hazardous weather conditions, and perform other crucial emergency procedures. Continued emphasis is placed on maintaining the safety of flight and developing sound judgment ("judgment training") throughout these conditions.

In addition, students will develop a keen understanding of advanced aerodynamics and the physics of flight to aid in decision-making and technical adjustments while working under simulated abnormal procedures. Finally, upon graduation, proficient students will be better prepared to begin flight training in pursuit of a private pilot's license should they choose. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*

Flight simulators are required in order to fully master many of the standards in this course. Instructors may use a range of equipment to meet this requirement, from simple computer software such as Microsoft Flight SimX to advanced freestanding simulators such as the Redbird FMX. This course also draws on preparation materials for the FAA Private Pilot Ground Test. Sample materials may be found on the FAA website or by order from Gleim Aviation at http://www.gleim.com/aviation/.

Program of Study Application

This is the capstone course in the *Aviation Flight* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Aviation Safety

1) Apply the safety concepts learned in previous classes to develop several detailed plans to potential problems faced in flight. To guide the planning, students should ask and then answer the question, "What would I do if……?" in response to problems such as, but not limited to:
    a. Aircraft door pops open just after lift off
    b. Engine fails at 100 feet AGL on takeoff
    c. Engine fails at 500 feet AGL on takeoff
    d. Oil on windshield on climb out
    e. Fuel being siphoned out of fuel tank on climb out due to an unsecured fuel cap
    f. Cabin fire
    g. Engine fire
    h. Minimum fuel situation
    i. Deteriorating weather
    j. Sick or unruly passenger
    (TN Reading 1, 2, 3)

2) Demonstrate understanding of the five hazardous thoughts and associated antidotes to each of the following:
    a. Anti-authority
    b. Impulsivity

      c.   Invulnerability
      d.   Macho
      e.   Resignation

Students will determine if they have one or more of these hazardous thoughts and explain what they do to realize when their decisions may be influenced by a hazardous thought. Students should also explain how they will counteract this thought in order to remain as safe as possible. (TN Reading 3)

Careers in Aviation

3) Demonstrate understanding and be able to explain the privileges and FAA requirements for each of the following pilot certificates and ratings:
    a. Certificates
        i. Sport
        ii. Private
        iii. Commercial
        iv. Airline Transport Pilot (ATP)
    b. Ratings
        i. Instrument
        ii. Sea Plane
        iii. Multi engine
        iv. Glider
    c. License (Mechanic)
        i. Airframe
        ii. Power Plant
    (TN Reading 1, 2, 3, 7, 9; TN Writing 4, 8, 9)

Systems Problem Solving

4) Describe the functions and characteristics of an airplane's aileron, elevator, and rudder, including the trim system if appropriate. Troubleshoot system problems to safely land aircraft in a variety of situations, including but not limited to:
    a. Frozen or stuck ailerons
    b. Frozen or stuck elevators
    c. Frozen or stuck rudder
    d. Taking off with a control lock still in place
    e. Aileron, elevator, or rudder hooked up backwards
    (TN Reading 3)

5) Describe the functions and characteristics of an airplane's power plant, and troubleshoot system problems to safely land aircraft in a variety of situations, including but not limited to:
    a. Partial engine failure
    b. Complete engine failure
    c. Low oil pressure
    d. High oil and/or cylinder head temperature
    (TN Reading 3)

6) Describe the functions and characteristics of an airplane's instrument systems, and troubleshoot system problems to safely land aircraft in a variety of situations, including but not limited to:
   a. Blocked pitot system
   b. Blocked static system
   c. Failed vacuum pump
   d. Failed flight gyros
   e. Two-way communications failure
   (TN Reading 3)

7) Describe the functions and characteristics of an airplane's fuel systems, and troubleshoot system problems to safely land aircraft in a variety of situations, including but not limited to:
   a. Low fuel
   b. Vapor lock
   c. Contaminated fuel
   (TN Reading 3)

8) Describe the functions and characteristics of an airplane's electrical systems, and troubleshoot system problems to safely land aircraft in a variety of situations, including, but not limited to:
   a. Alternator/generator failure
   b. Alternator/generator overcharging
   c. Electrical fire
   d. Popped circuit breaker(s)
   e. Runaway electric trim
   f. Electrical smoke
   (TN Reading 3)

Advanced Aerodynamics and Physics of Flight

9) Research, understand, and be able to explain the aerodynamics force that affect an aircraft on the ground and in flight. Anticipate, prevent, and recommend actions to recover from unsafe flight conditions such as, but not limited to:
   a. Becoming airborne at too slow an airspeed in ground effect
   b. Aircraft stalling at an unsafe altitude
   c. Aircraft spin
   d. High density altitude airport operations
   (TN Writing 7, 8, 9)

10) Explain the effects of high-density altitudes on aircraft takeoff distances, aircraft rate of climb, aircraft angle of climb, Indicated Airspeed (IAS) versus True Airspeed (TAS), and landing distances. (TN Reading 9)

Trends and Emerging Technologies

11) Drawing on industry magazines, scholarly research, and news media, explore in an informational essay the chief features, advantages, and disadvantages of emerging aviation technologies, such as unmanned aerial vehicles (UAVs) and mobile technologies gaining prominence in aviation fields. Discuss how these technologies work, how they have impacted (or are expected to

impact) the aviation industry, and their impact on aircraft safety. (TN Reading 7, 9; TN Writing 2, 4, 8, 9)

Emergency Procedures
In order to demonstrate mastery of the following standards students must: (a) be able to determine that there is a problem or failure, (b) determine the problem or failure, (c) properly recall the appropriate emergency procedure memory checklist, (d) refer to the appropriate written emergency checklist, (e) determine the best plan to deal safely with the problem or failure, (f) and how to safely land the aircraft. Moreover, students must be able to realize there may be multiple problems or failures that can occur at one time; they must be able to develop a plan of action that will deal with the failures while safely flying the aircraft.

12) Demonstrate the ability to follow an emergency procedure for a <u>low fuel</u> situation. Read, recite, and complete the appropriate memory and non-memory checklists in front of peers or in a mock emergency situation while safely flying the aircraft. (TN Reading 3)

13) Demonstrate the ability to follow an emergency procedure for an <u>aircraft fire</u> situation. Read, recite, and complete the appropriate memory and non-memory checklists in front of peers or in a mock emergency situation while safely flying the aircraft. (TN Reading 3)

14) Demonstrate the ability to follow an emergency procedure for a <u>medical emergency</u> situation. Read, recite, and complete the appropriate memory and non-memory checklists in front of peers or in a mock emergency situation while safely flying the aircraft. (TN Reading 3)

15) Demonstrate the ability to follow an emergency procedure for a <u>deteriorating weather</u> situation. Read, recite, and complete the appropriate memory and non-memory checklists in front of peers or in a mock emergency situation while safely flying the aircraft. (TN Reading 3)

16) Demonstrate the ability to follow an emergency procedure for a <u>two-way radio failure</u> situation. Read, recite, and complete the appropriate memory and non-memory checklists in front of peers or in a mock emergency situation while safely flying the aircraft. (TN Reading 3)

17) Demonstrate the ability to follow an emergency procedure for a <u>partial or complete engine failure</u> situation. Read, recite, and complete the appropriate memory and non-memory checklists in front of peers or in a mock emergency situation while safely flying the aircraft. (TN Reading 3)

Problems with Aircraft Performance and Weight & Balance

18) Consult the manufacturer's approved limits for an aircraft's center of gravity. Explain the associated problems when the aircraft's center of gravity is forward or aft of the approved limits. Given a designated degree of imbalance, determine and demonstrate in a mock setting how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved takeoff CG envelope. Correctly use a moment index to plot these changes on a loading graph to aid in the demonstration, attending to appropriate units, quantities, and terminology. (TN Reading 3, 4; TN Math N-Q, A-APR, A-REI, F-TF, G-GM)

19) Consult the manufacturer's approved maximum takeoff weight. Explain the associated problems when the aircraft's takeoff weight is greater than approved by the manufacturer. Calculate the proper reduction in weight for various combinations of passengers and cargo; be "able and willing" to reduce the payload as needed to bring the aircraft within the manufacturer's approved takeoff weight. (TN Reading 3, 4; TN Math N-Q, A-APR, A-REI, F-TF, G-GM)

Cross-Country Planning

20) Determine the different factors involved in planning the best route on each leg of a cross-country flight. For each factor, describe why it should be considered when determining the route, citing, by contrast, what could go wrong if the factor was not considered. Examples include the following:
   a. Shortest distance
   b. Lowest terrain
   c. Best emergency landing options
   d. Smoothest air
   (TN Reading 3)

21) Determine the different factors involved in calculating the best altitude to fly on each leg of a cross-country flight. Factors may include the following:
   a. VFR – Easterly heading (odd thousand + 500') or Westerly heading (even thousand + 500')
   b. IFR – Easterly heading (odd thousand) or Westerly heading (even thousand) (below FL 290)
   c. Distance between departure airport and destination airport
   d. Headwind/tailwind components at different altitudes
   e. Terrain features
   f. Emergency landing options
   g. Smoothest air
   h. Pressurized versus non-pressurized aircraft
   Given a specific route, calculate optimum altitude for all stages of a cross-country flight, incorporating consideration of the factors identified above and relying on sectional and world aeronautical charts, aircraft specifications, and other resources to make proper determinations. (TN Reading 3; TN Math N-Q)

22) Given a specific flight route, determine the headwind/tailwind component on each leg of a cross-country flight. Specifically,
   a. Determine forecast winds aloft for each leg
   b. Determine best altitude for each leg
   c. Determine headwind/tailwind component for each leg
   (TN Reading 3; TN Math N-Q, A-APR, A-REI, F-TF, G-GM)

23) Given a specific flight route, determine the estimated groundspeed on each leg of a cross-country flight. Specifically,
   a. Determine altitude
   b. Determine true airspeed (TAS)
   c. Determine headwind/tailwind component
   d. Determine crosswind component

  e. Determine estimated groundspeed (GS)
~~(TN Reading 3; TN Math N-Q, A-APR, A-REI, F-TF, G-GM)~~

24) Given a specific flight route, determine the estimated magnetic heading required for each leg of a cross-country flight. Specifically,
  a. Determine True Course (TC) / Magnetic Course (MC)
  b. Determine crosswind component
  c. Determine True Heading (TH)
  d. Determine amount of variation; show how to add variation if it is a Westerly variation and subtract variation if it is an Easterly variation
  e. Determine Magnetic Heading (MH)
~~(TN Reading 3; TN Math N-Q, A-APR, A-REI, F-TF, G-GM)~~

25) Citing relevant examples and supporting texts, explain to both a lay audience and a technical audience the concept of estimated time enroute (ETE) and the effect of flying through different time zones. For a given scenario, determine and communicate departure and arrival times in local times and GMT. ~~(TN Reading 2; TN Math N-Q)~~

26) Correctly simulate how to complete, file, activate, and close or cancel a VFR flight plan, following proper procedures and determining the information requested in each box of the flight plan. ~~(TN Reading 3)~~

27) Research, role play, communicate, and write about the factors involved in correctly departing from and arriving at an airport. For each of the following, consult and cite the Airman's Information Manual and FAA guidelines when modeling the behaviors necessary for successful takeoff and landing, including communications with ground control, air traffic control, any passengers, and relevant superiors, peers, and authorities:
  a. Controlled airport – Departure
    i. ATIS
    ii. Clearance delivery (assigned headings, altitudes, transponder codes, departure frequencies)
    iii. Ground control (taxi instructions)
    iv. Tower (VFR flight plan activation)
    v. Departure control

  b. Controlled airport – Arrival
    i. ATIS
    ii. Approach control (tower)
    iii. VFR flight plan closure
    iv. Ground Control (taxi instructions)
  c. Non-controlled airport – Departure
    i. AWOS
    ii. CTAF / Unicom (pre-taxi communication, pre-takeoff communication)
    iii. Proceeding on course
    iv. VFR Activation with FSS
  d. Non-controlled airport – Arrival
    i. AWOS

ii. CTAF / Unicom (airport advisory, pre-pattern communication, pattern communication, base communication, clearing runway communication)
iii. VFR flight plan closure with FSS via radio or telephone
~~(TN Reading 2, 3, 4, 9; TN Writing 4, 9)~~

Federal Aviation Regulations (FARs)

28) Demonstrate understanding and be able to explain important FARs that relate to Private Pilot operations included in the following, citing specific text and wording from the regulations:
   a. FAR Part 1
   b. FAR Part 21
   c. FAR Part 39
   d. FAR Part 43
   e. FAR Part 61
   f. FAR Part 71
   g. FAR Part 91
   h. NTSB Part 830

Articulate why these regulations are necessary and analyze how the FAA has structured the FARs in order to quickly retrieve such information in the future. ~~(TN Reading 1, 2, 4, 5)~~

Judgment Training

29) Continue to explore and demonstrate understanding of proper techniques for improving pilot judgment and decision-making skills in every aspect of the pre-flight, in-flight, and post-flight stages.

FAA Private Pilot Written Exam Preparation
Note on the FAA Private Pilot Exam: Throughout all three courses in the Aviation Flight program of study, students will be exposed to the FAA Private Pilot written exam questions based on the material being covered. Upon completion of this course, students may qualify to sit for the exam at the discretion of the instructor, and based upon performance on a practice exam as indicated below.

30) Students will demonstrate mastery of corresponding course content for the FAA Private Pilot written exam when achieving a score of 80% on a practice 60-question exam.

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 6, 7, and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~

- o ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 1, 3, 5, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity, Algebra, Functions, Geometry.~~
  - o ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, functional, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Foundations of Distribution & Logistics

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6069
Prerequisite(s):	None
Credit:	1
Grade Level:	9-10
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the first course in the *Distribution & Logistics* program of study.
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	503, 776
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Foundations of Distribution & Logistics exposes students to careers and businesses involved in the planning, management, and movement of people, materials, and products by road, air, rail, and water. As an introduction to this important and globally evolving field, this course covers the basic principles of logistics, reviews the history and development of distribution networks, and examines how they function within the dynamics of the supply chain. Upon completion of this course, proficient students will explore career options; demonstrate an understanding of the historical, current, and future

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significance of the distribution and logistics industries; and plan for the effective and efficient flow of goods and services. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the foundational course in the *Distribution & Logistics* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Occupational Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with the appropriate handling and storage methods of materials in accordance with local, state, and federal safety and environmental regulations.
    a. Inspect, maintain, and employ safe operating procedures with tools and equipment used in the warehouse and transportation area. Identify, demonstrate, and specify situations in which safety equipment such as harnesses, personal protective equipment (PPE), and eye wash stations are to be used.
    b. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures. Differentiate between a recordable and non-recordable incident and describe the impact that each can have on a facility.
    c. Maintain a portfolio record of passed written safety examinations and equipment examinations.
    ~~(TN Reading 3, 4; TN Writing 4)~~

Career Investigation

2) Identify and analyze career pathways within the Distribution & Logistics field. Cite supporting evidence from multiple career information sources, such as O*NET OnLine, to summarize the essential knowledge and skills required for these careers. Complete one or more career aptitude surveys, analyze the results, and compose an essay describing the relationships between personal career aptitudes and careers in Distribution & Logistics. ~~(TN Reading 1, 2, 9; TN Writing 2, 4, 8, 9)~~

3) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to investigate local and regional occupational opportunities and trends in the field of distribution and logistics. Synthesize collected data to develop an illustration comparing occupations by education requirements, job availability, salaries, and benefits. ~~(TN Reading 2, 7; TN Writing 4, 8, 9)~~

History and Development of Distribution and Logistics

4) Synthesize research from informational texts to create an annotated timeline on the history of distribution and logistics. Using descriptive text, identify cultural, social, economic, and technological factors that have influenced the development of distribution and logistics. ~~(TN Reading 2, 9; TN Writing 2, 4, 7, 9)~~

5) Analyze the importance of distribution and logistics in a global society. Investigate the influences of customer demands, ordering and managing inventory, forecasting, controlling inbound and outbound shipments, reducing costs, and saving time in product and service flow. ~~(TN Reading 9; TN Writing 2, 4, 7)~~

6) Describe the ways that companies can gain a competitive advantage using logistics to distribute their products and services. Research media profiles of businesses that made their operations more sophisticated through the use of logistics management, and explain the factors that contributed to their success. ~~(TN Reading 1, 2)~~

Components of Logistics, Transportation & Distribution

7) Research the components of logistics planning. Create a diagram depicting a network for a hypothetical product, labeling all of the nodes (fixed spatial points where goods stop for storage or processing) and links (the transportation network that connects the nodes) in the network. Prepare an accompanying paper or presentation that explains the diagram and describes what is happening at each node. ~~(TN Reading 4, 7; TN Writing 4, 7)~~

8) Explore the five modes of transportation (truck, train, plane, ship, pipeline) used to move materials by land, air, or sea. For each mode of transportation, analyze the costs, benefits, and problems associated with that mode of transportation, including environmental impact. List items that are most often transported by each type of transportation. ~~(TN Reading 1, 4; TN Writing 2, 4)~~

9) Examine the various types of distribution centers and describe how materials feed into and flow from each type in an illustrated paper. Include the following categories, as well as hybrid facilities where these categories overlap:
   a. Package handling center
   b. Warehouse or fulfillment center
   c. Cross-dock facility
   d. Bulk break center
   ~~(TN Reading 1, 4, 7; TN Writing 2, 4)~~

Supply Chain Functions

10) Define the term supply chain and determine how the distribution and logistics domains fit within the larger supply chain. Develop a graphic illustration of a selected industry and map the movement of primary inputs and outputs on a global or local scale.

11) Research and describe the four major flows—product flow, information flow, financial flow, and demand flow—that occur in a supply chain. Analyze the impact that each has on the supply chain as a whole and the interactions that must occur between the flows. (TN Reading 1, 4, 7; TN Writing 2, 4, 7)

12) Differentiate between the internal supply chain and external supply chain of an organization, including internal and external customers. Write an informative paper and accompanying graphic that describes how the two chains are interrelated. (TN Reading 1, 4, 7; TN Writing 2, 4, 7)

13) Research the following terms as related to supply chains: lean, green, and sustainable. Define and describe each term and give examples of ways they are implemented in a supply chain. (TN Reading 1, 4; TN Writing 4)

14) Create a glossary of terms related to supply chains and their management. Include acronyms. Add new terms to the glossary as they are encountered. (TN Reading 4; TN Writing 4)

15) Gather and analyze information from multiple authoritative sources (i.e., industry magazines, academic journals) to explain how the following functions work together to support the distribution of products and services:
    a. Transportation
    b. Warehousing
    c. Inventory control
    d. Material handling
    e. Information and communication systems
    (TN Reading 1, 4, 7; TN Writing 2, 4, 8)

Problem Solving

16) Create a list of the decisions that must be made, and the problems that could potentially arise, in a complex supply chain. Research individual and group problem-solving and decision-making strategies and prepare a presentation indicating which strategies would be best for each of the decisions or problems on the list. (TN Reading 1, 2, 4; TN Writing 4, 6)

17) Apply problem-solving and decision-making strategies to recommend and defend solutions to supply chain issues such as:
    a. Identifying efficient delivery routes having 3 or 4 stops
    b. Minimizing costs of parts and delivery charges from different sources using different modes of transportation
    (TN Reading 3, 4, 5, 7; TN CSS Writing 1, 2, 7; TN Math N-Q, F-BF, F-LE)

Management and Information Technology

18) Investigate the tools and processes used by companies to manage the flow of inputs and outputs within a supply chain. Determine how barcodes, radio frequency identification (RFID), unique identification (UID), and tagging methods (active and passive) are employed in the tracking and distribution of product flow. (TN Reading 5, 6)

19) Determine the ways that computers and other information technologies are used in a supply chain. Create a table or chart listing technologies/software that are used, and describe how they improve supply chain function. For example, discuss the impact of automated warehouses on distribution and logistics functions within a company. ~~(TN Writing 2, 4, 8)~~

Case Study

20) Synthesize information from industry, scholarly, and popular media sources outlining how a top 20 retailer has used supply chain management to become one of the largest retailers in the world. Create a model and presentation describing how the retailer handles the following areas of its global supply chain network:
   a. Customer service
   b. Distribution costing
   c. Distribution planning
   d. Information technology
   e. Materials and purchasing management
   f. Order processing systems
   g. Transport and inventory management
   ~~(TN Reading 1, 4, 7, 8; TN Writing 2, 4, 7, 8)~~

Standards Alignment Notes

*References to other standards include:
- ~~TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 8 and 10 at the conclusion of the course.~~
- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5 and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity, Functions.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- o Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Distribution & Logistics I

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6072
Prerequisite(s):	*Foundations of Distribution & Logistics* (6069)
Credit:	1
Grade Level:	10-11
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the second course in the *Distribution & Logistics* program of study.
Necessary Equipment:	None
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	503, 776
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Distribution & Logistics I prepares students for entry into the warehouse and distribution career field. Course content emphasizes a deep understanding of the dynamics of distribution and logistics

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operations, the warehousing skills needed for the tracking and managing of inventory, and the problem-solving skills used by logisticians in today's complex business environments. Upon completion of this course, a proficient student will be have a thorough understanding of safety, tools, equipment, operations, processes, customer fulfillment, product lifecycle, future trends, and regulatory issues in the industry. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Program of Study Application

This is the second course in the *Distribution & Logistics* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Occupational Safety

1) Demonstrate the ability to comply with personal and environmental safety practices associated with the appropriate handling and storage methods of materials in accordance with local, state, and federal safety and environmental regulations.
    a. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
    b. Interpret Material Safety Data Sheets (MSDS) to determine any hazards related to materials handled. Use appropriate signs and symbols to identify hazardous materials within warehouses and during transportation of the materials.
    c. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
    d. Identify dangerous goods and be able to discuss how they influence warehouse and transportation decisions; and determine the appropriate corrective actions if faced with a hazardous situation, as outlined by the *Emergency Response Guidebook* published by the U.S. Department of Transportation.
    ~~(TN Reading 3, 4; TN Writing 4)~~

Logistics & Transportation

2) Research the four subdivisions of logistics in light of organizational management practices and prepare an explanatory paper or presentation that discusses the similarities and differences between the subdivisions:
    a. Business logistics
    b. Military logistics
    c. Event logistics
    d. Service logistics
    ~~(TN Reading 1, 4; TN Writing 2, 4, 6, 7, 9)~~

3) While variations exist from organization to organization, the following functions are often included under the logistics umbrella. Synthesize information from textbook(s), print and online

industry sources to describe each. Create a graphic illustrating how they interact with one another and write an accompanying explanatory narrative that indicates how each affects product costs and profitability.

 a. Transportation
 b. Warehouse and storage
 c. Intermodal freight transport
 d. Materials handling
 e. Inventory control
 f. Order fulfillment
 g. Inventory forecasting
 h. Production planning/scheduling
 i. Customer service
 j. Facility location
 k. Return goods handling
 l. Parts and service support
 m. Salvage and scrap disposal

(TN Reading 1, 4, 7; TN Writing 2, 4, 6, 7, 9)

4) Describe the tradeoffs that occur between transportation and inventory costs. Drawing on examples from real products and companies, explain when it is more profitable to use more expensive transportation and maintain smaller inventory, and when it is more advantageous to use cheaper transportation and maintain larger inventories. Discuss the application of key concepts such as Just-in-Time (JIT) strategy, lean dynamics, and Kanban systems. (TN Reading 1, 4, 7, 8; TN Writing 1, 4, 8)

5) Demonstrate the ability to calculate and explain to others the purchase cost, ordering cost, and holding cost for a given material or product within the supply chain. Determine total cost as a function of these costs and demonstrate the effects on profit for a specified price and quantity. (TN Reading 3, 4; TN Math N-Q, A-CED, F-IF, F-BF)

6) Perform inventory calculations to minimize costs as would a logistics manager for a given company. Using algebraic reasoning and appropriate units, determine the economic order quantity (EOQ) and reorder point (ROP) for a given product. Research forecasting models for the specified product and to understand how companies predict EOQ and ROP using logistics management. (TN Reading 3, 4, 9; TN Math N-Q, A-CED, F-IF, F-BF)

Warehousing

7) Compare and contrast the warehousing requirements for a variety of different products including items such as perishable foods, hazardous chemicals, large items like furniture and appliances, school supplies, seasonal items, and subassemblies for the manufacture of a given product. (TN Reading 1; TN Writing 4, 7, 8)

8) Write an informative report describing different warehouse layouts and equipment used to move materials in each. Differentiate between bulk and rack storage, and indicate situations when each is employed. List the three categories of aisle spacing and describe the advantages and disadvantages of each. (TN Reading 1, 4; TN Writing 2, 4, 7)

9) Investigate various warehouse management system (WMS) software programs and create a comparison chart that could be used by a warehouse manager to select software to meet the specific needs of his/her operation. (TN Reading 1, 4, 7; TN Writing 2, 4, 8)

10) Demonstrate the ability to complete and interpret warehouse documents including, but not limited to, packing slips, bills of lading, advance shipment notices, distribution sheets, pick lists, invoices, special orders, and inventory forms. (TN Reading 3, 4, 5, 6)

Regulations

11) Create a chart listing international, national, state, and local agencies and organizations that regulate some part of the supply chain and the role played by each. Indicate what areas each agency has jurisdiction over. Example agencies include:
   a. U.S. Department of Transportation (DOT)
   b. U. S. Customs and Border Protection (CBP)
   c. Homeland Security (HS)
   d. Environmental Protection Agency (EPA)
   e. Occupational Safety and Health Administration (OSHA)
   f. World Shipping Council
   g. United Nations, including the International Maritime Organization (IMO)
   h. International Organization for Standardization (ISO)
   i. World Customs Organization (WCO)
   j. City and county laws and ordinances
   k. State laws
   (TN Reading 1, 4; TN Writing 2, 4, 8)

12) Analyze the impact of international trade agreements on logistics decisions. (TN Reading 1, 2, 4; TN Writing 7, 8, 9)

13) Research International Commercial Terms, also known as INCOTERMS®, developed by the International Chamber of Commerce. Create a table or chart to indicate what each of the three letter standard terms means by delineating the respective obligations of the buyer and seller involved in the delivery of goods from the Seller to the Buyer. (TN Reading 4; TN Writing 4)

Problem Solving

14) Solve given problems related to transportation of goods and warehousing by evaluating data and presenting solutions or recommending appropriate decisions. Use spreadsheets and/or other software in calculating "what if" scenarios as appropriate. Types of problems should include scenarios such as:
   a. Selecting routes and modes of transportation between a distribution center and various markets
   b. Calculating the carbon footprint of similar products shipped from different locations and by different modes of transportation
   c. Optimizing warehouse usage
   d. Planning for the moving and handling of hazardous goods
   e. Analyzing the impact of natural disasters on supply chain

      f.   Developing strategies for working toward the sustainable use of specific materials and modes of transporation
(TN Reading 3, 4; TN Writing 4, 7, 8; TN Math N-Q, A-CED, F-IF, F-BF)

15) Given a selected case, plan for the storage, movement, and delivery of a specified good or service from one location to another. Using logistics data and applying concepts learned in the course, justify the tradeoff decisions (i.e., mode of transport, holding time, delivery constraints such as fuel cost) in the proposed plan, coherently explaining the logic behind each choice as if presenting to a senior manager. For example, outline the plan for fulfilling an order for a personal computer by a fixed date and transporting it through customs to a purchaser in a foreign country. (TN Reading 3; TN Writing 1, 4, 7, 8, 9; TN Math N-Q, A-CED, F-IF, F-BF)

Trends

16) Analyze case studies of the logistics operations of various retail companies to see how they plan for and adjust their operations to remain competitive with companies such as Amazon, WalMart, and Kroger. (TN Reading 1, 4; TN Writing 4)

17) Using websites and journals from professional organizations related to transportation, distribution, and logistics, identify five trends that are impacting local, regional, national, and international supply chains. Trends could include such factors as rising fuel costs, movements toward fully automated warehouses, and greening the supply chain. Summarize research in an informative essay that includes:
      a.   description of the trend and explanation of how it affects the supply chain,
      b.   examples of how various businesses are responding to the trend, and
      c.   an outline of the information that must be considered before a business implements any change, including a formal cost-benefit analysis.
(TN Reading 1, 4, 8; TN Writing 2, 4, 6, 7, 8)

Project

18) Work with a local business to analyze its supply chain. Create a report and presentation with graphics and map(s) that depicts both the incoming supply chain and outgoing supply chain. Indicate what modes of transportation and types of warehousing operations it uses. Outline changes that it has made or plans to make in its supply chain and why it made/will make them. (TN Writing 2, 4, 6)

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 5, 6, and 10 at the conclusion of the course.

- ~~TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).~~
  - ~~Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.~~
- ~~TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity, Algebra, Functions.~~
  - ~~Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.~~
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- *Emergency Response Guidebook:*
  http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2012.pdf

Distribution & Logistics II: Management

Primary Career Cluster:	Transportation, Distribution, & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6024
Prerequisite(s):	*Distribution & Logistics I (6072)*
Credit:	1
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution, & Logistics courses.
Programs of Study and Sequence:	This is the third and final course in the *Distribution & Logistics* program of study.
Necessary Equipment:	None
Aligned Student Organization(s):	SkillsUSA: http://tnskillsusa.com/ Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://tn.gov/education/topic/work-based-learning.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	503, 776
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics

Course Description

Distribution & Logistics II: Management prepares students for a capstone learning experience in logistics, planning, and management systems. A range of business tasks will be undertaken to support the operation of supply chain processes including coordinating and controlling the order cycle and associated information systems. Through exposure to crucial business activities such as project

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management, analyzing logistical problems, and producing new solutions, students will acquire advanced skills related to business professionalism, ethics, policies, and communication. Upon completion of this course, a proficient student will be prepared for further education and careers in the distribution and logistics industry. ~~Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.*~~

Work-Based Learning Framework

Optional internship** standards outlined below may take the form of work-based learning (WBL) opportunities (such as internships, cooperative education, service learning, and job shadowing) or industry-driven project-based learning. These experiences must comply with the Work-Based Learning Framework guidelines established in SBE High School Policy 2.103. As such, this course must be taught by a teacher with an active WBL Certificate issued by the Tennessee Department of Education and follow policies outlined in the Work-Based Learning Policy Guide available online at https://tn.gov/education/topic/work-based-learning. The Tennessee Department of Education provides a Personalized Learning Plan template to ensure compliance with the Work-Based Learning Framework, state and federal Child Labor Law, and Tennessee Department of Education policies, which must be used for students participating in WBL opportunities.

Program of Study Application

This is the third and final course in the *Distribution & Logistics* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution, & Logistics website at https://tn.gov/education/article/cte-cluster-transportation-distribution-logistics.

Course Standards

Occupational Safety

1) Create a safety procedures manual for new employees working in a warehouse facility. Outline in the manual the personal and environmental safety practices associated with the appropriate handling and storage methods of materials in accordance with local, state, and federal safety and environmental regulations.
    a. Include employee responsibilities and protocols for adhering to regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
    b. Include information on how to interpret Material Safety Data Sheets (MSDS) to determine any hazards related to materials handled.
    c. Include the appropriate signs and symbols that must be used to identify hazardous materials within warehouses and during transportation of the materials. ~~(TN Reading 3, 4; TN Writing 4)~~

2) Prepare and deliver a safety demonstration on the use of a specific piece of safety equipment or personal protective equipment (PPE).

Communications and Professionalism

3) Practice effective verbal, nonverbal, written, and electronic communication skills for working with customers, employees, dispatchers, wholesalers, and retailers. Demonstrate the ability to listen attentively, speak courteously and respectfully, discuss client ideas/vision, resolve conflicts, and respond to customer objections or complaints to the customer's satisfaction. (TN Writing 4)

4) Collect Codes of Ethics from various transportation, distribution, and logistics-related professional organizations and/or companies, and examine areas of commonality. Analyze what these statements say about the work culture at a particular organization, and identify company values that resonate with one's own. Discuss how one would look for evidence of positive values when conducting a job search. Synthesize principles from the codes investigated to create a personal code of ethics, to be included in a career portfolio compiled throughout the course. (TN Reading 1, 2, 4, 5, 6, 9; TN Writing 4, 8, 9)

5) Research job descriptions, career information, and online job boards to identify desirable employability skills and character traits for professionals working in the area of transportation, distribution, and logistics. Compile a class list of those skills and attributes. For each item on the class list, define the characteristic, state why it is important for people working in the field, and list at least two ways to build that skill. Possible skills include:
   a. Collaboration
   b. Honesty
   c. Reliability
   d. Communication
   e. Responsibility
   f. Problem-solving
   g. Ability to work under pressure
   (TN Reading 1, 4; TN Writing 4, 8)

Distribution and Logistics Technology

6) Demonstrate proficiency with Microsoft Office programs by using them to complete class assignments including writing papers, making presentations, solving problems, keeping records, and managing data. (TN Writing 6)

7) Research the different applications of computers and programmable controllers in managing distribution and logistics operations. Find examples of the software and technology used for those applications. Create a catalog sorted by type of application that includes the following:
   a. A generic description of the purpose of each type of software/technology included. Possible categories to include are electronic commerce (e-commerce); barcode software; enterprise resource planning (ERP); distribution resource planning (DRP); and electronic data interchange (EDI).
   b. An entry for each specific software/technology that falls in the application category, including graphics, product description, key features, best uses, and a link to the product website.
   (TN Reading 2, 4, 7; TN Writing 2, 4, 6, 7)

8) Write an explanatory paper describing the benefits of having all of an organization's software programs integrated so that information is only entered once. Cite evidence from case studies, articles, and other sources. (TN Reading 1, 4, 7; TN Writing 2, 4, 7, 8)

Warehousing Management
Note: For the following standards, teachers are encouraged to leverage relationships with local businesses to bring in representatives for class discussions and/or supply examples of management processes and other relevant documents.

9) Gather information from field visits, texts, and personal communications with business representatives to create layout plans for processing incoming and outgoing, cross-docking, and storage of products. Provide a sketch of the shipping and receiving area and write out a standard operating procedure for each. (TN Reading 1, 4, 7)

10) Create a flow chart for the processing of incoming goods and materials using standardized industry protocols and procedures. Include processes for dealing with damaged, incorrect, and incomplete orders. (TN Reading 3, 7; TN Writing 4)

11) Simulate the work of a warehouse manager or logistician by planning for the shipment of a product. Given a set of constraints, such as a specified timetable, destination, quantity, or other factor, determine the number of pallets needed and assign dock doors to accommodate the appropriate number of loads. (TN Reading 3, 4; TN Math N-Q, A-CED)

12) Develop a written profile of how a local business coordinates and controls the order cycle and associated information systems of scheduling, cost analysis, documentation confirmation, packing lists, MSDS, product seals, packaging types, packaging labels, and routing issues. Include a description of the performance metrics used to monitor the quality, quantity, cost, and efficiency of the movement and storage of goods. (TN Writing 2, 4)

13) Apply skills learned in Distribution & Logistics courses to analyze a case study in which the supply chain for a particular product or company was disrupted. In a written paper or presentation, describe what went wrong and how management addressed the problem. Discuss whether or not the issue was resolved, and the impact it had on either the supply chain or the industry as a whole. For example, analyze the 2002 Long Beach Port Strike and demonstrate through graphic representations and narrative writing how the strike impacted a range of manufacturers, retailers, and consumers in multiple locations. (TN Reading 2, 9; TN Writing 2, 4, 7, 9)

Capstone Project

14) Plan a distribution center. In a written plan complete with accompanying graphic illustrations, charts, and/or tables, outline the following:
    a. Select a location for the center and indicate on a map the service area for the distribution center.
    b. Using online mapping applications, identify businesses within the area that could be potential customers.

c. Determine the type of distribution center to build based on potential customers—for example, a retail distribution center, a service parts distribution center, a catalog or e-commerce distribution center, or a 3PL (3rd party) distribution center.

d. Include a brief description of how each of the following operations will be handled at the distribution center: dock operations, receiving operations, storage operations, picking operations, packaging operations, shipping operations, processing returns.

e. Evaluate possible material handling and storage equipment for use in the distribution center.

f. Investigate the modes of transportation to be used to ship materials and develop guidelines for when each should be used. Consider truck, rail, air transport, maritime transport, intermodal, and outsourcing as methods of moving product.

g. Develop clearly defined and measurable metrics to assess progress, and supply sample cost and revenue projections based on specified inventory, overhead, variable costs, and other inputs.

(TN Reading 1, 4, 7; TN Writing 1, 2, 4, 5, 6, 8, 9; TN Math N-Q, A-CED, F-IF, F-BF)

Career Portfolio

15) Compile important artifacts that represent professional and personal skill attainment to create a career portfolio. Develop a plan to distribute the electronic portfolio as part of a career job search and/or admission to a postsecondary program. Portfolio items may include:

- Attainment of technical skill competencies, licensures or certifications, recognitions, awards, and scholarships
- Documentation of extended learning experiences, such as community service and professional organizations, or internship
- Abstract of technical competencies mastered during the practicum
- Resume
- Examples of best work
- Other artifacts compiled in previous courses

(TN Reading 1, 8; TN Writing 4, 9)

Internship Option**

16) Participate in a work-based learning internship experience to develop, practice, and demonstrate skills outlined in the standards above and in previous courses in this program of study. An internship should follow current Tennessee work-based learning guidelines as appropriate.

17) Create and continually update a personal journal to document internship activities. Draw connections between the experience and course content, thoughtfully reflecting on:

a. Acquired leadership skills
b. Problem-solving techniques and decision-making skills
c. Team member participation in a learning environment
d. Personal career development

(TN Writing 2, 4)

18) Upon conclusion of the internship, write an informative essay summarizing the internship experience and next steps for personal and professional growth. Produce a technology-enhanced class presentation showcasing highlights, challenges, and lessons learned from the internship. (TN Writing 2, 4, 6)

** Although a hands-on experience in work-based learning (WBL) is desired, it is recognized that not all students can be placed in a working establishment. Comparable placement in a school-based/district-based enterprise may be substituted if available.

Standards Alignment Notes

*References to other standards include:
- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: Tennessee State Standards for Mathematics: Math Standards for High School: Number and Quantity, Algebra, Functions (pages 58-83).
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
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