



# Energy and the Environment (PLTW)

<b>Primary Career Cluster:</b>	Science, Technology, Engineering, and Mathematics (STEM)
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<b>Course Code:</b>	0886
<b>Prerequisite(s):</b>	None
<b>Credit:</b>	N/A
<b>Grade Level:</b>	8
<b>Graduation Requirement:</b>	N/A
<b>Coursework and Sequence:</b>	This is a course in the <i>Project Lead the Way (PLTW)</i> middle school sequence of coursework.
<b>Necessary Equipment:</b>	Visit <a href="http://www.pltw.org">www.pltw.org</a> for more information.
<b>Aligned Student Organization(s):</b>	Technology Student Association (TSA): <a href="http://www.tntsa.org">http://www.tntsa.org</a> Tracy Whitehead, (615) 532-2804, <a href="mailto:Tracy.Whitehead@tn.gov">Tracy.Whitehead@tn.gov</a>
<b>Coordinating Work-Based Learning:</b>	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit <a href="https://tn.gov/education/topic/work-based-learning">https://tn.gov/education/topic/work-based-learning</a> .
<b>Available Student Industry Certifications:</b>	N/A
<b>Dual Credit or Dual Enrollment Opportunities:</b>	N/A
<b>Teacher Endorsement(s):</b>	001, 007, 013, 014, 015, 016, 017, 018, (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), 070, 081, 105, 121, 122, 123, 124, 125, 126, 127, 128, 129, 144, 145, 147, 157, 210, 211, 212, 213, 214, 230, 231, 232, 233, 400, 401, 402, 407, 413, 414, 415, 416, 417, 418, 440, 460, 461, 470, 477, 480, 481, 482, 483
<b>Required Teacher Certifications/Training:</b>	Teachers who have never taught this course MUST attend the training provided by PLTW and receive PLTW certification. This course has an associated fee through the vendor.
<b>Teacher Resources:</b>	<a href="https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework">https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework</a>

## Course Description

This is a course in the series of *Project Lead the Way (PLTW)* curriculum. For more information, visit the PLTW website at <http://www.pltw.org/>.

## Program of Study Application

These courses build knowledge and skills related to the following career clusters:

- 1) Architecture & Construction
- 2) Information Technology (IT)
- 3) Manufacturing
- 4) Science, Technology, Engineering & Mathematics (STEM)
- 5) Transportation, Distribution, & Logistics

## Course Standards

The course standards outlined below are the copyrighted property of *Project Lead the Way*. Teachers must participate in *Project Lead the Way* training in order to be able to teach this course. This course is one in a series of PLTW middle school courses. The lesson numbers below reflect the recommended sequence.

### Lesson 3.1 Investigating Energy (14 days)

#### *Understandings*

- 1) Two types of energy exist: potential (stored energy) and kinetic (energy in motion).
- 2) Energy sources can be renewable, exhaustible, or inexhaustible. There are advantages and disadvantages to each.
- 3) The six main forms of energy include solar or light radiation, thermal, electrical, mechanical, chemical, and nuclear.
- 4) Energy efficiency and conservation are necessary in order to minimize pollution, improve business/economy, reduce dependence on foreign sources, and reduce our carbon footprint to create a sustainable world.
- 5) Energy can be transferred, or moved, from one object to another.
- 6) Energy can be transformed, or changed, from one form to another.
- 7) The second law of thermodynamics states that not all energy is 100 percent efficient when it is converted from one form to another.
- 8) Work is measured in Joules and is defined as force acting over a distance. Power is measured in Watts and is defined by how fast work is done.
- 9) Engineers, designers, and engineering technologists are high demand for the development of future technology to meet societal needs and wants.

#### *Knowledge and Skills*

It is expected that students will:

- Describe the differences between, and the advantages and disadvantages of exhaustible, inexhaustible, renewable, and non-renewable energy sources.
- Describe the six main forms of energy; including solar or light radiation, thermal, electrical, mechanical, chemical, and nuclear.
- Differentiate between potential and kinetic energy.
- Identify global energy uses and explain trends toward future demands.

- Demonstrate ways to increase the efficiency of energy used in homes and at school.
- Calculate financial savings and explain effects of our carbon footprint as a result of using energy efficiently.
- Use the design process to design, model, and test a wind turbine for efficiency.
- Calculate power and work by measuring force, distance, and time using the wind turbine model.
- Describe the roles and responsibilities of STEM professionals for high demand technological careers.

### **Lesson 3.2 Sustainable Energy (15 days)**

#### *Understandings*

There are events and issues that challenge us to use energy wisely and to develop alternate forms of energy, including economic and population growth, natural disasters, and conflicts with countries that provide the United States with oil.

- 1) Fossil fuel use and greenhouse gas emissions can be reduced by using innovative means to implement renewable and inexhaustible energy sources.
- 2) Energy sources can be used to produce electricity and hydrogen, energy carriers that provide the greatest diversity and lowest impact on the environment.
- 3) Decisions regarding the implementation of alternative energy sources involve the weighing of tradeoffs between predicted positive and negative effects on the environment and financial burden.
- 4) Careers in sustainable engineering will be created because our planet needs environmentally sustainable solutions to support population growth and preserve our limited natural resources.

#### *Knowledge and Skills*

It is expected that students will:

- Graph data that represents energy consumption, energy imports, and energy production.
- Recognize that alternative energies are not always available in every location.
- Recognize that the solution to our energy needs now and in the future will include conservation and wise use of resources as well as a wide variety of sources.
- Describe the roles and responsibilities of STEM careers that help solve environmental problems.
- Identify alternative forms of energy, explain why they are alternative, and identify the advantages and disadvantages of each.
- Identify challenges in transferring alternative energies from where they are produced to where they are consumed.
- Research an alternative energy solution used for a specific purpose that will reduce the nation's dependency on fossil fuels.

### **Lesson 3.3 Making an Impact (16 days)**

#### *Understandings*

- 1) Water plays a critical role in our daily lives; it should be used wisely and users should be conscientious about conserving water.

- 2) Environmental engineering focuses on developing a sustainable future, preventing pollution, and assessing the environmental impact of integrated waste management systems.
- 3) The seven steps of integrated waste management include reduce, reuse, recycle, compost, incineration that creates usable energy, landfills, and incineration with no usable energy created.
- 4) Engineers must consider a product's life cycle when designing because every product has an impact on the environment.
- 5) Every individual impacts the environment through the choices they make in energy consumption and garbage disposal.
- 6) Using energy efficiently will reduce the need for new power plants and utility infrastructure and will reduce the need to burn fossil fuels to produce energy, thereby reducing greenhouse gas emissions that contribute to climate change.
- 7) Heat transfer occurs through conduction, convection, and radiation.

### *Knowledge and Skills*

It is expected that students will:

- Calculate daily water consumption for a building such as a home or school and recommend water conservation strategies.
- Identify ways that individuals can reduce the effect on the environment through their energy choices and garbage disposal.
- Identify how STEM professionals are involved in integrated waste management and other environmental careers.
- Understand the difference between energy conservation and energy efficiency and be able to calculate both.
- Differentiate between conduction, convection, and radiation as forms of energy transfer.
- Compare the temperature of different materials to determine which are better at preventing heat transfer.
- Design an experiment to investigate the prevention of heat transfer.
- Evaluate a design to reduce heat transfer by weighing the amount of ice remaining; propose improvements for the design.