PBS Lesson Series

Math: Grade 5, Lesson 19, Apply Volume Formulas

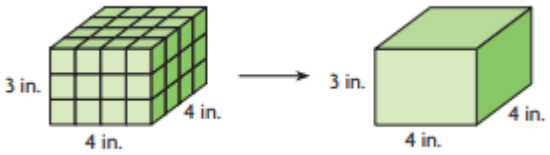
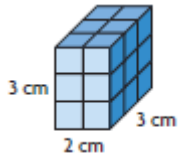
Lesson Focus: Apply Volume Formulas
Practice Focus: Students will focus on applying the formula V=l x w x h and V = B x h.
Objective: Students will use the volume formulas to calculate the volume of rectangular prisms.
Key Vocabulary: volume, cubic units, length, width, height
TN Standards: 5.MD.C.5a, 5.MD.C.5b
Teacher Materials:

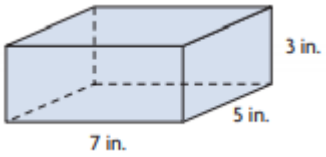
- Paper/pencil or board/marker
- Student Practice Packet
- Centimeter cubes

Student Materials:

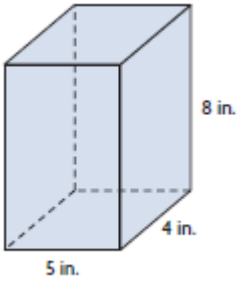
- Paper and a pencil, and a surface to write on

Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 5th graders out there, though all children are welcome to tune in. This lesson is the nineteenth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!** **If you didn't see our previous lesson, you can find it on the TN Department of Education's website at www.tn.gov/education. You can still tune in to today's lesson if you haven't seen any of our others. But it might be more fun if you first go back and watch our other lessons since we'll be talking about things we learned previously.** **Today we will be learning about how to apply the formulas for volume in order to solve problems involving the volume of rectangular prisms in mathematics! Before we get started, to participate fully in our lesson today, you will need:** • **Paper and pencil** • **The student packet for Math, Grade 5, Lesson 19 which can be found at www.tn.gov/education.** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (5 min.) **In the previous lesson, we learned about using the area of the base of a rectangular prism and multiplying it by the**	Previous lessons in this series focused on developing a foundation for understanding volume using unit

number of repeated layers. Today, we will continue working with rectangular prisms and use a formula to find the volume. **Let's start today's lesson with a warm-up problem that will help us make some connections to what we know about volume.** [Display and read the problem aloud.] **What do you notice that is different about the two rectangular prisms at the top of the page?** [Pause.]  **Yes, one is composed of 1-inch unit cubes and the other is not.** **What is the same about the rectangular prisms?** [Pause.] **Yes, they both have the same dimensions.** **Will they both have the same volume? Why?** [Pause.] **Yes, because they are both the same size.** **You might remember that we learned about using the area of the base and the height to find the volume. Let's look at this problem.** [Display image.]  **From the diagram, I see that the base has a length of 2 centimeters and a width of 3 centimeters.** [Point to the second part of the image showing the area of the base.] **To find the area of the base, I know I need to multiply.** [Say and write.] **Base = 2x3** **So, the area of the base = 6 cm^2** **I can also see in the diagram that there are 3 layers which means the height is 3. If each layer has 6 cubes, then I just need to multiply the area of the base (6) times the height (3).** [Write and say.]	cubes, leading to the formulas V=l x w x h and V=Bxh. This introduction transitions students to a more abstract reasoning with problems involving volume of rectangular prisms.

6 x 3 = 18 so, the volume equals 18 cubic cm. **Let's solve some similar problems together as we continue our new learning.**	
Teacher Model (10 min.) Objective 1: The teacher will explicitly instruct and model how to use the formula V=l x w x h when measuring the volume of a rectangular prism. **Let's look at this diagram of a rectangular prism as we think about this problem.** [Display image below.]  [Read aloud.] **Mike is making a box to hold his favorite DVDs. The length of the box is 7 inches, the width is 5 inches and the height is 3 inches. What is the volume of the box Mike is making?** **We can use a formula to find the volume of a rectangular prism.** [Display image below or write on board.] $Volume = length \times width \times height$ $V = l \times w \times h$ **Because of the commutative property, the order in which the dimensions are multiplied is not important, but labeling the dimensions help clarify the formula. The base of a prism is usually the length and width, while the vertical dimension is usually the height.** **Let's remember this as we identify the length, width, and height of the rectangular prism.** [Fill in numbers as you go.] **Length =** **Width =** **Height =** **Looking at the information in the diagram, what is the length and width?** [Pause.] **Yes, the length and width are 7 inches and 5 inches.** [Point to the 7- and 5-inch edges.]	Objective #1: Students will follow along with the teacher, applying the formula V=l x w x h to solve contextual problems.

What is the height? [Pause.] **Good. The height is 3 inches.** **This gives us the dimensions to find the area of the base and we can multiply that by the height to find the volume!** **Now, we can multiply the length by the width.** [Write the equation.] **The product of 7 and 5 is 35** **What does the product of the length and width represent?** [Pause.] **Yes, the length times the width is the area of the base.** **Now, we need to multiply the product of the length and width by the height.** **35 x 3= 105** **So, the volume of Mike's DVD box is 105 cubic inches.** [As you say the following, write the formula: V=l x w x h.] **We can write this as the formula Volume equals length times width times height.** **Using the formula, our equation would be V= 7 x 5 x 3 which gives us the answer 105 cubic inches.** Objective 2: The teacher will model how to find the volume of a rectangular prism by applying formula V=Bxh. **Hmm, since we know that the length times the width is the area of the base, we could also write the formula as** [Write and say V=Bxh.] **volume equals the area of the base times height.** **Using this formula, our equation would be V=35 x 3.** [Display.] *Volume – Base area × height* $V = B \times h$ B – area of the base shape, h – height of the solid figure. **Let's apply this formula to a similar problem.** [Read and display image.] **Emilio's family has a sandcastle kit. The kit includes molds for several solid figures that can be used to make sandcastles. One of the molds is a rectangular prism like the one shown at the right. How much sand will it take to fill the mold?**	Objective #2: With teacher's guidance, students will reason with a contextual problem to apply the formula V=Bxh.



Let's think. The problem is asking us to find the amount of sand it will take to fill the space inside of the mold. What will we be measuring? [Pause.]

Of course! We will be finding the volume of the mold.
Let's use the formula V=B x h. [Refer to the images below and fill in the information as you think aloud.]

Volume = Base area × height
$V = B \times h$
B = area of the base shape,
h = height of the solid figure.

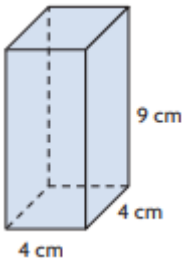
Let's identify the length, width, and height of the rectangular prism. [Fill in numbers as you go.]
Length =
Width =
Height =

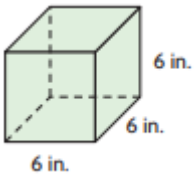
Looking at the information in the diagram, what is the area of the base? [Pause.]
Yes, the area of the base is 5 x 4 which equals 20.

What is the height? [Pause.]
Good. The height is 8 inches.
This gives us the dimensions to find the volume!

[Write and say the equation, fill in numbers as you go.
V = B × h
V = _ × _
V = _ cu in.]

The Volume equals the area of the base times the height.
Using this formula, we can find the volume of Emilio's mold.
[Write and read aloud the following.]
We already found that the base was 5x4, or 20, and the height is 8.

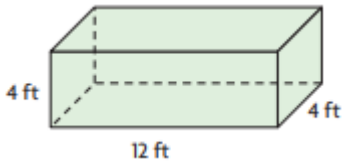
V= 20 x 8 **What is the product of 20 and 8?** [Pause.] **Good job! 20 times 8 equals 160.** **So, Emilio's sand mold has a volume of 160 cubic inches.** Tying the learning together: **Let's look back at the solution to the first problem we solved (Mike's problem). Do you see the formula V=area of the base times height in the solution to the problem solved?** [Pause.] **I see it! It's the same equation in the second part of our solution!** [Point to where you previously wrote 35 x 3 = 105.] **Interesting connection!** **Let's look at some more examples together.**	Tying the learning together: Students will consider how the two formulas for volume are related to each other.
<u>Guided Practice</u> (10 min.) [I do.] **Cindy is making a box to hold her favorite beads. The length of the box is 4 cm, the width is 4 cm and the height is 9 cm. What is the volume of the box Cindy is making?**  **To find the volume of this rectangular prism, I'll use the information from the problem to identify the length, width, and height of the rectangular prism.** [Write the following and fill in numbers as you go.] Length = Width = Height **=** **Looking at the information in the diagram, what is the length?** [Pause.] **Yes, the length is 4 cm** **What is the width?** [Pause.] **Right, the width is 4 cm.** **What is the height?** [Pause.]	[I do.] Students work alongside the teacher as the teacher thinks aloud. These problems connect to the learning model.

Good. The height is 9 cm. **This gives me the dimensions I need to multiply to find the volume!** [As you say the following, write the formula: V= l x w x h.] **I can use the formula Volume equals length times width times height.** **Using the formula, my equation would be V= 4 x 4 x 9** **What is the product of 4 times 4?** [Pause.] **Yes, 4 x 4 = 16** **Now, what is the product of 16 and 9?** [Pause.] **Excellent! 16 x 9 = 144** **So, the Volume of Cindy's box is 144 cubic cm.** [We do.] **Here's a similar problem.** **Work through this problem along with me.** [Display and read the following problem.] **Susan needs a box to hold her erasers. She wants a box with the length of 6 in, the width of 6 in and the height of 6 in. What is the volume of the box Susan wants to find?**  **To find the volume of this rectangular prism, we will use the information from the problem to identify the length, width, and height of the rectangular prism.** [Write the following and fill in numbers as you go.] Length = Width = Height **=** **Looking at the information in the diagram, what is the length?** [Pause.] **Yes, the length is 6 inches** **What is the width?** [Pause.] **Right, the width is 6 inches.** **What is the height?** [Pause.] **Good. The height is 6 inches.**	[We do.] Students will respond to teacher questions with less scaffolding than the previous example. Students will have more time to think and respond on their own prior to the teacher providing solutions.

Now that you have the dimensions you need, what will you do with them to find the volume? [Pause.] **You're right! You can now use the formula to multiply.** [As you say the following, write the formula: V=l x w x h.] **Remember, the formula for finding Volume is length times width times height.** **Try using the formula now.** [Pause for about 1 minute.] **Did you use the formula to create the equation V= 6 x 6 x 6?** [Pause.] **Great! 6 x 6 x 6 = 216 because 6 x 6 = 36 and 36 x 6 = 216.** **So, the Volume of Susan's box is 216 cubic in.**	
[Second, We do.] **Let's solve this next problem together.** [Display and read aloud.] **I can arrange 1 cm unit cubes in the base of a box in 4 rows of 5 cubes without any gaps. The height of the box measures 5 inches. What is the volume of the box?** **We can use the formula for volume to solve this problem. What will our equation be?** [Pause.] **Did you say that we would multiply the number of rows and columns at the base (which gives us the area of the base) by the height of the box?** [Pause.] **Good thinking! So, our equation will be V=4 x 5 x 5** [Write the equation.] **What is the product of 4 and 5?** [Pause.] **Yes, 4 times 5 equals 20. And what is the product of 20 and 5?** [Pause.] **Very good! 20 times 5 equals 100. So, the volume of the box is 100 cubic cm.**	
[You do.] **Now, it's your turn to solve on your own! After you've had a few minutes to work, we'll come back together and check it. Ready?** [Pause.] **Great! Here's your problem:** [Display and read aloud.]	[You do.] Students are working almost exclusively independently with the teacher providing answers at the end.

John's father is installing an aquarium. The base of the aquarium is 12 feet long and 4 feet wide. The height of the aquarium is 4 feet. How many cubic feet of water is needed to completely fill the aquarium?

Find the volume of this rectangular prism.



Try using the formula to find the volume. Work on your own for about 2 minutes. Then, we'll come back together.
[After approximately 1 minute, alert students that you will come back together in 1 more minute.]

Are you ready for us check your work? [Pause.]
Okay, great!
[Display the following as you and the student check work together.]

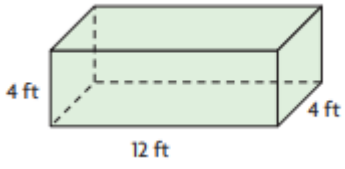
Did you use the formula V=l x w x h? [Pause.]
Good! Then your equation should have been V=12 x 4 x 4.
What is the product of 12 x 4 x 4? [Pause.]
Great Job! The product is 192.

So, you should have that the volume of the aquarium is 192 in^3.

Great work, everyone!

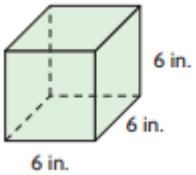
Additional Problems (if needed): [display images]
Find the volume.

1.



12 x 4 = 48 ft., 48 x 4 = 192 cubic ft.

2.



6 x 6 = 36 in., 36 x 6 = 216 cubic in.	
Independent Practice (1 min.) **Great work, boys and girls! Today, we reviewed solving for volume using rectangular prisms. I hope you're seeing some connections to area and volume! You sure did a great job! After the video, you will have some problems to practice on your own. I will show you the independent practice problems now, or you can find them in the student practice for this lesson posted on our website, www.tn.gov/education.** [Teacher shows student practice page under document camera or camera zooms in on student practice page.] **Good luck and do your best!**	
Closing (1 min) **Boys and Girls, I enjoyed reviewing volume formulas to calculate the volume of rectangular prisms! Thank you for inviting me into your home. I look forward to seeing you in our next lesson in Tennessee's At Home Learning Series! Bye!**	