

Math: Grade 5, Lesson 17, Understand Volume

Lesson Focus: Understand Volume

Practice Focus: Students will focus on recognizing volume as an attribute of solid figures and understand concepts of volume measurement in order to measure volumes.

Objective: Students will use visual representations of unit cubes to determine the volume of rectangular prisms with a focus on counting both the number of cubes in each layer and the number of layers, and by multiplying the number of unit cubes in the base by the number of layers (the height); building towards the volume formula.

Key Vocabulary: volume, cubic units, length, width, height

TN Standards: 5.MD.C.3b, 5.MD.C.4

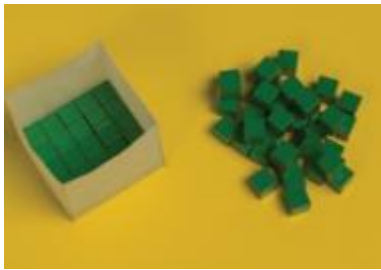
Teacher Materials:

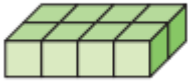
- Paper/pencil or board/marker
- Student Practice Packet
- Centimeter cubes, packing box

Student Materials:

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

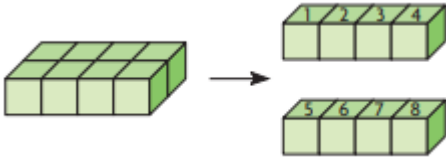
Teacher Do	Student Do
<p><u>Opening</u> (1 min)</p> <p>Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 5th graders out there, though all children are welcome to tune in. This lesson is the seventeenth in our series.</p> <p>My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!</p> <p>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 see 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.</p> <p>Today we will be learning about volume as an attribute of solid figures and understand concepts of volume measurement in order to measure the volume of rectangular prisms in mathematics! Before we get started, to participate fully in our lesson today, you will need:</p> <ul style="list-style-type: none">• Paper and pencil• The student packet for Math, Grade 5, Lesson 17 which can be found at www.tn.gov/education.	<p>Students get materials ready for the lesson.</p>

<p>Ok, let's begin!</p>	
<p><u>Intro</u> (5 min.)</p> <p>In the previous lesson, we learned about using unit cubes to construct solid figures that have length, width, and height. Today, we will continue working with solid figures as we think about volume.</p> <p>When you hear the word volume, what do you think of? [Write "Volume".] [Pause.] Interesting! I heard you say that volume can mean how loud a sound is. Volume can also mean the amount of space a rectangular prism, like this packing box, can hold.</p> <p>In mathematics, we think about volume as the measure of the amount of space a solid figure occupies. [Show students an empty packing box.] Volume is measured in cubic units. So, if we needed to know how much space is inside this box, we would need to measure the cubic volume of the box.</p> <p>How can we use unit cubes to find the volume of a rectangular prism like this box? [Show students this picture or use your own packing box with cubes.]</p>  <p>We could start filling the box with 1 cm unit cubes making sure that there are no empty spaces and no overlaps. Counting the total number of cubes it takes to fill the box will tell us the cubic volume.</p> <p>Let's look at this rectangular prism and see if we can determine its volume. [Project or build the following image.] How many unit cubes are used to make this rectangular prism? [Pause.] Yes! There are 8 unit cubes. So, this rectangular prism has a volume of 8 cubic units. I will show you how I got that answer.</p>	<p>This warm-up supports students' understanding of volume as they move beyond counting unit cubes, transitioning towards cubic units of measurement.</p> <p>This introduction foreshadows the work of the teacher model.</p>



[Model counting each row of cubes.]

1, 2, 3, ..., 7, 8. We can also say that there are 2 rows of 4 cubes. [Write and say.] $2 \times 4 = 8$ cubed units. We used multiplication to find the volume of this rectangular prism.



Now let's solve some similar problems together.

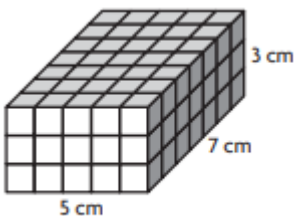
Teacher Model (10 min.)

Objective 1: The teacher will explicitly instruct and model how to use the number of cubes in each layer times the number of layers to find the volume of a rectangular prism.

Remember that volume is the measure of the amount of space a solid figure occupies.

Volume is measured in cubic units. How can we use unit cubes to find the volume of this rectangular prism?

[Pause.]



We could count all the 1cm cubes, but I might lose track because there are so many.

Instead, we can use the information from the problem to help us find the volume.

First, we need to know the number of unit cubes in the bottom layer, or the base, of the prism. In other words, we need to know how many cubes are on the bottom layer.

Objective #1:

Students will watch and listen as the teacher uses multiplication to find the volume of a solid figure.

Remember, not all the cubes are visible, but they still need to be counted. How can we use the visible length and width to figure out the total number of cm cubes in the base? [Pause.] Excellent idea! Just like before, we can use the information provided and multiplication to tell us how many cubes are in the bottom layer, or the base.

We know that it is 5 unit cubes long, times 7 unit cubes wide. So, 5×7 will tell us the number of unit cubes that make up the base. What is 5×7 ? [Pause.]

Yes! $5 \times 7 = 35$.

So, altogether, there are 35 unit cubes that make up the bottom layer, or the base of the prism.

The prism is made up of 3 layers of unit cubes. [Point to the given dimension in the drawing.] That means it is 3 cubic units high. If all 3 layers have 35 cubic units, then how can you use multiplication to determine the total number of unit cubes that make up this rectangular prism? [Pause.]

Yes! The number of cubes in each layer times the number of layers will give us the total number of cubes in the rectangular prism, or its volume. [Write and say $35 \text{ cubic units} \times 3$.]

What is 35×3 ? [Pause.]

Great! $35 \times 3 = 105$ [Pause.]

Each unit cube has a volume of 1 cubic cm.

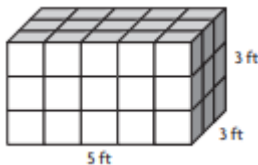
So, the volume of the prism is 105 cubic cm.

$3 \times 35 = 105 \text{ cubic cm}$

So, to find the total number of cubes that fill a rectangular prism, we need to multiply the number of layers by the number of cubes in 1 layer.

Objective 2: The teacher will model how to find the volume of a rectangular prism.

Here's a similar problem. [Display the following problem.]



Objective #2:

Students will use multiplication to determine the number of unit cubes in the base layer of a rectangular prism and apply their understanding of multiplication as equal groups of to determine the cubic volume of a rectangular prism.

How can you use the provided information to find the volume of this rectangular prism? [Pause.]

Yes, I can find the number of unit cubes in the base of the rectangular prism, and then multiply that number by the number of layers that make up its height. Then I can write the volume in cubic units.

So first, we need to know the number of unit cubes in the base of the prism. How many unit cubes are in the base? [Pause.]

Yes, there are 5 unit cubes that make up the length of the base. [As you think aloud, write length = 5.]

How many unit cubes make up the width of the base? [Pause.] There are 3 unit cubes that make up the width of the base. [As you think aloud, write width = 3.]

So, we can use multiplication to find that altogether, there are 15 unit cubes that make up the base of the prism. [Write $5 \times 3 = 15$]

How many unit cubes make up the height of the base? [Pause.] There is 1 unit cube that makes up the height of the base.

Now, let's count the number of layers of cubes that make up the prism. [Point to and count each layer.] 1, 2, 3. The prism is made up of 3 layers of unit cubes. [Height = 3]

Now, we can use multiplication to find the total number of cubes that fill the prism. We need to multiply the number of layers by the number of cubes in each layer.

$3 \times 15 = 45$ unit cubes

Each unit cube has a volume of 1 cubic ft.

So, the volume of the prism is 45 cubic ft.

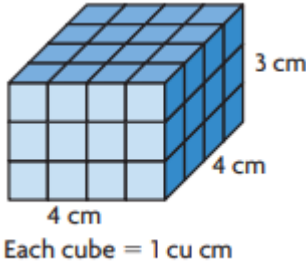
Tying the learning together:

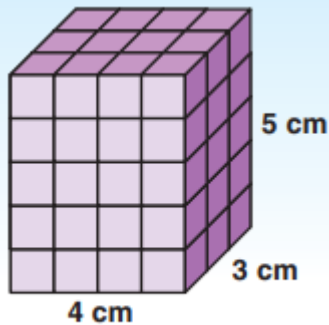
How is multiplication helping us find the volume of a rectangular prism? [Pause.]

Good point! By finding the number of unit cubes that it takes to fill the base of the rectangular prism, and counting the number of repeated layers, we can multiply the equal sets of cubes in each layer by the number of layers that make up its height.

Tying the learning together:

Students will review the strategy used in this lesson and consider how they are related.

<p>Let's look at some more examples together.</p>	
<p><u>Guided Practice</u> (10 min.) [I do.]</p>  <p>To find the volume of this rectangular prism, we first need to find the number of unit cubes in the base of the prism. How many unit cubes are in the base? [Pause.] Yes, there are 4 unit cubes that make up the length and 4 unit cubes that make up the width. How many unit cubes make up the height of the base? [Pause.] There is 1 unit cube that makes up the height of the first base. So, by multiplying them all together, we know that there are 16 unit cubes that make up the base of the prism.</p> <p>Now, let's count the number of layers of cubes that make up the prism. Count them with me. [Point to and count each layer.] The prism is made up of 3 layers of unit cubes.</p> <p>Now, to find the total number of cubes that fill the prism, we need to multiply the number of layers by the number of cubes in each layer. [Write the equation as you think aloud.] There are 3 layers of 16 cubes. $3 \times 16 = 48$ unit cubes So, the volume of this rectangular prism is 48 cubic cm.</p> <p>[We do.]</p>	<p>[I do.] Students work alongside the teacher as the teacher thinks aloud.</p> <p>[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.</p>



Here's a similar problem.

Work through this problem along with me. [Display the image above.]

To find the volume, we need to know the number of unit cubes in the base of the rectangular prism. How many unit cubes are in the base? [Pause.]

Yes, there are 12, because there are 3 unit cubes that make up the length and 4 unit cubes that make up the width of the base. $3 \times 4 = 12$.

How many unit cubes make up the height of the base?

[Pause.] **There is 1 unit cube that makes up the height of the base.**

Now, let's count the number of layers that make up the height of the prism. [Point to and count each layer].

The rectangular prism is made up of 5 layers of unit cubes.

Now, we need to find the total number of cubes that fill the prism. We need to multiply the number of layers by the number of cubes in each layer. How many layers of unit cubes do we have? [Pause.]

Yes, 5.

How many unit cubes do we have in each layer?

Yes, 12.

[Write the equation as you say it aloud.]

So, $5 \times 12 = 60$ unit cubes

Since each unit cube has a volume of 1 cubic cm, the volume of the prism is 60 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.

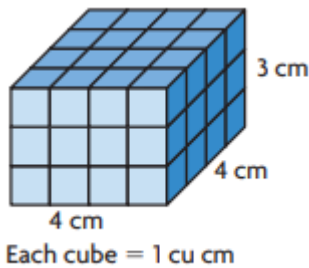
[You do.]

Students are working almost exclusively independently with the

Ready? [Pause.]

Great! Here's your problem: [Display and read aloud.]

Find the volume of this rectangular prism.



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 find the number of cubes that make up the base?

[Pause.]

Great! You should've multiplied 4 times 4 to get 16.

How many unit cubes make up the height of the base?

[Pause.] **Yes! You're right! There is 1 unit cube that makes up the height of the base.**

Did you find the height of the rectangular prism? [Pause.]

Great! The height is 3.

Did you multiply the number of unit cubes that make up the base times the number of layers? [Pause.]

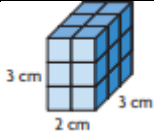
Excellent! You should've multiplied 3×16 which should have gotten you 48.

So, the volume = 48 cubic cm

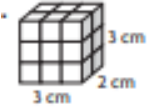
Great work, everyone!

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

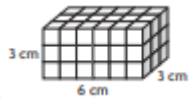
teacher providing answers at the end.



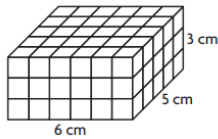
1.
 $2 \times 3 = 6$ cm is our base, 1 unit cube makes up height of base,
 6×3 layers = 18
 The volume is 18 cubic cm.



2.
 $3 \times 2 = 6$ cm is our base, 1 unit cube makes up height of base,
 6×3 layers = 18
 The volume is 18 cubic cm.



3.
 $6 \times 3 = 18$ cm is our base, 1 unit cube makes up height of base,
 18×3 layers = 54
 The volume is 54 cubic cm.



4.
 $6 \times 5 = 30$ cm is our base, 1 unit cube makes up height of base,
 30×3 layers = 90
 The volume is 90 cubic cm.

Independent Practice (1 min.)

"Great work, boys and girls! Today, we reviewed using multiplication to determine the volume of rectangular prisms with a focus on counting both the number of cubes in each layer and the number of layers. 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!"

PBS Lesson Series

Closing (1 min)

Boys and Girls, I enjoyed reviewing visual representations of unit cubes to determine the volume of rectangular prisms with a focus on counting both the number of cubes in each layer and the number of layers with you! 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!

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