

Math: Grade 5, Lesson 18, Volume of Rectangular Prisms

Lesson Focus: Volume of Rectangular Prisms

Practice Focus: Students will focus on practicing volume and applying the volume formula in order to calculate the volume of rectangular prisms.

Objective: Students will use the volume formula 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
<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 eighteenth 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 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.</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 18 which can be found at www.tn.gov/education. <p>Ok, let’s begin!</p>	<p>Students get materials ready for the lesson.</p>
<p><u>Intro</u> (5 min.)</p> <p>In the previous lesson, we learned about using unit cubes to calculate the length, width, and height of a rectangular</p>	<p>This warm-up supports students’ understanding of volume as they make connections to the operations of multiplication and addition and</p>

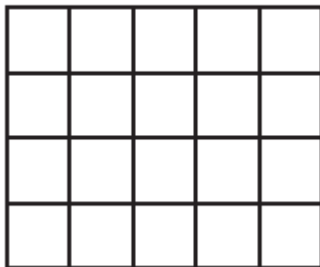
prism. Today, we will continue working with rectangular prisms as we think about volume.

Let's start today's lesson with a warm-up problem that will help us think about how volume is connected to multiplication and measuring area.

[Display and read the problem aloud.]

Seth is planning a new deck for his backyard. What is the area of the deck?

Deck Plan



What do we know about this problem? [Pause.]

Right, we know that we need to measure the area for Seth's new deck. What do you recall about area? [Pause.]

Right! Area is the measure of a flat, 2-dimensional space.

You might recall that to measure the area of a rectangle, we multiply the length times the width.

Hmm, look at Seth's diagram of his plan.

What is the length and width? [Pause.]

Right, the length is 5 square units, and the width is 4 square units. So, what will the area of his deck be? [Pause.]

You're right! The length times the width, which is 5 times 4, is 20. So, the area is 20 square units.

Now, let's think about how this problem might be related to finding the volume of a rectangular prism.

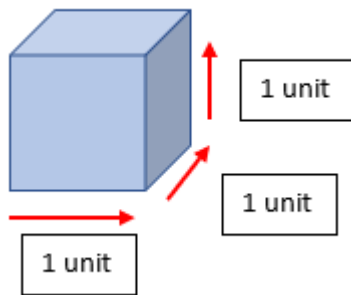
The base of a rectangular prism is a rectangle. You know that area is measured in square units, or units², and that the area of a rectangle can be found by multiplying the length and the width.

Volume is measured in cubic units, or units³. Unit cubes measure 1 unit x 1 unit x 1 unit. Some examples of units

finding the area of a rectangle to determine the area of the base of a rectangular prism.

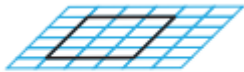
This introduction foreshadows the formula of $V = B \times h$ where B is the area of the base.

might be centimeters, inches, or feet. [Display the diagram below.]



When you build a prism and add each layer of cubes, you are adding a third dimension, height.

[Display image.]



The area of the base

Let's keep thinking about this as we solve some similar problems together

Teacher Model (10 min.)

Objective 1: The teacher will explicitly instruct and model how to use the area of the base as repeated layers to determine height when measuring the volume of a rectangular prism.

[Display image Below.]

Yuan built the rectangular prism shown below, using 1-inch unit cubes. The prism has a base that is a rectangle and has a height of 4 cubes.

What is the volume of the rectangular prism that Yuan built?

[Pause.]

You can find the volume of a prism in cubic units by multiplying the number of square units in the base shape by the number of layers, or its height.

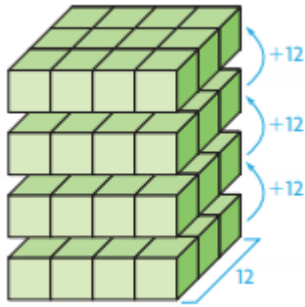
How many cubes are in each layer of Yuan's rectangular prism? [Pause.]

Yes, it is composed of 12 1-inch cubes.

We'll use this information to solve the next part of this problem.

Objective #1:

Students will follow along with the teacher, observing the connections between multiplying the length times the width of a right rectangular prism which can be viewed as determining how many cubes would be in each layer if the prism were packed with or built up from unit cubes.



[Display image below or draw on the board; add to it as you go.]

Look at this table and think about how we might complete it. Let's think. If we know that the base is 12 cubic inches, and that each additional layer is the same as the base, then what is the cubic volume of 2 layers?

Height (in layers)	1	2	3	4
Volume (in cubic inches)	12	24		

So, our base layer is 12. If we have 2 layers, we have how many cubes? [Pause.]

Yes, 2 layers will be 24 cubic inches because 12 cubic inches plus another 12 cubic inches equals 24 cubic inches.

What will 3 layers be? [Pause.]

Yes! 3 layers will be another 12 cubic inches which brings us to 36.

Now, how about 4 layers? [Pause.]

Excellent! 4 layers will be another 12 cubic inches which brings us to 48.

How does the volume change as each layer is added? [Pause.]

Yes, the volume increases by the number of cubic units in each layer, 12.

What does the number you multiply the height by represent? [Pause.]

Yes, the volume increases by the number of cubic units in each layer, 12.

So, the volume of Yuan's rectangular prism is 24 in.³

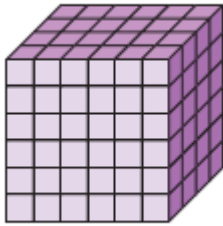
Objective 2: The teacher will model how to find the volume of a rectangular prism by multiplying the base times the height and by multiplying length times width times height.

Objective #2:

With teacher's guidance, students will reason with a contextual problem to determine the cubic volume of a rectangular prism using multiplication.

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

Toni stacks cube-shaped beads that measure 1 centimeter on each edge in a storage box. The box can hold 6 layers of 24 beads with no gaps or overlaps. What is the volume of Toni's storage box?



To find the volume of Toni's box, we can use the information that his box can hold a certain number of cube-shaped beads. So, Let's think about the information we have: [Write and fill in the following as you think aloud.]

The volume of each bead is 1 cm cubed

The storage box has a base with an area of 24 cm cubed

The height of the storage box is 6 cm

What is the volume of each bead? [Pause.]

Yes! Each bead has a volume of 1 cubic cm.

Do we know the area of the base of the box?

[Pause.]

You're right! We know that the base layer can hold 24 beads that are each 1 unit, so the area of the base must equal 24.

Now, the problem tells us that the box holds 6 layers of 24 beads. What must the height of the box be? [Pause.]

Good thinking! The height must be 6 cm.

So, the volume of the box can be found by multiplying the base area times the number of layers [Write the equation below.]

$$(24 \times 6) = 144 \text{ cm cubed}$$

Toni's box has a volume of 144 cubic cm.

Hmm, I'm wondering; in our solution what does the number 24 represent? [Pause.]

Right! It represents the area of the base of Toni's box which is the length times the width! One way the beads could be arranged in the base is 6 rows of 4 beads.

So, another way we could think of the equation is like this:
 [Write the equation.] **the length times width of the base,**
times the height.
 $(6 \times 4) \times 6 = 144 \text{ cm cubed.}$

How is this equation the same as the previous equation?

[Pause.]

Interesting! The 24 in the first equation was replaced with its factors 6 and 4.

Tying the learning together:

Think back about the problem we solved with Seth's deck.
In that problem, we measured area.

How are volume and area different? [Pause.]

Yes, area is the number of square units needed to cover a two-dimensional surface. Volume is the number of cubic units needed to fill a three-dimensional space.

Let's look at some more examples together.

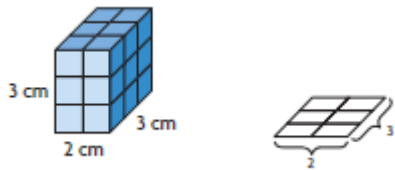
Guided Practice (10 min.)

[I do.]

Follow along with me as I think through this problem.

[Display and read aloud.]

Find the volume of this rectangular prism.



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 = 2×3

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.]

$6 \times 3 = 18$ so, the volume equals 18 cubic cm.

[We do.]

Here's a similar problem.

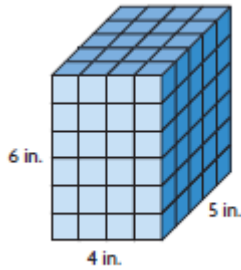
Tying the learning together:

Students will review the strategy used in this lesson and consider how they are related to finding the area of a rectangle.

[I do.]

Students work alongside the teacher as the teacher thinks aloud.

Work through this problem along with me. [Write the following problem and display image.]



The length of the rectangular prism is ____.
 The width is ____ So, the area of the base is ____.
 The height is ____ So, the volume of the prism is ____.

Let's find the volume of this rectangular prism.

Looking at the diagram, I notice that we're given the dimensions.

What is the length of the rectangular prism? [Pause.]

Did you say 4 inches, or 5 inches? [Pause.]

Because of the commutative property of multiplication, either answer is correct! The length can be seen as 4 inches [Point to the 4 inch edge of the base.], **or you might see the 5 inch edge as the length.** [Point to the 5 inch edge of the base.]
For this problem, I'll decide that the length is the edge that measures 4 inches.

So, if we've decided that the length is going to be 4 inches, what is the width of the rectangular prism? [Pause.]

Good, the width is 5 inches.

Can you determine the area of the base with this information? [Pause.]

Good job! The area of the base is 4 inches times 5 inches. Which is 20 square inches.

Now, what is the height of the rectangular prism? [Pause.]

Great! The height is 6 inches.

Now, to find the volume, we can multiply the area of the base times the height. [Write the equation as you say.] **That's 20 times 6. $20 \times 6 = 120$**

So, the volume is 120 cubic inches.

[You do.]

[We do.]

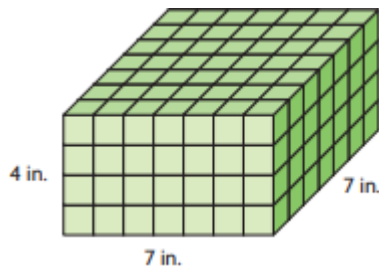
Students will respond to teacher questions with less scaffolding than the previous example. Students will have more time to think and respond on their own prior to the teacher providing solutions.

[You do.]

Students are working almost exclusively independently with the teacher providing answers at the end.

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.]
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.]

What is the area of the base? [Pause.]

Yes, 49 square inches.

What is the height? [Pause.]

Yes, 4.

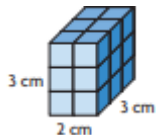
Did you multiply 4×49 ? [Pause.]

If so, you should have gotten 196 in^3

Great work, everyone!

Additional Problems (if needed): [Display images.]

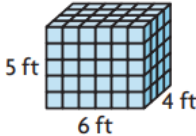
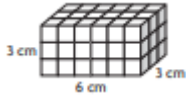
Find the volume. [Follow the same script as the I do.]



1.

$2 \times 3 = 6 \text{ cm}$ for the base, $6 \times 3 = 18 \text{ cubic cm}$

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 <p>5 ft 6 ft 4 ft</p> <p>2. $6 \times 4 = 24$ ft for the base, $24 \times 5 = 120$ cubic ft</p>  <p>3 cm 6 cm 3 cm</p> <p>3. $6 \times 3 = 18$ cm, $18 \times 3 = 54$ cubic cm</p>	
<p><u>Independent Practice</u> (1 min.)</p> <p>Great work, boys and girls! Today, we reviewed using the area of the base as repeated layers to determine height when measuring the volume of a rectangular prism. 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.]</p> <p>Good luck and do your best!</p>	
<p><u>Closing</u> (1 min)</p> <p>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!</p>	

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