

Math: Grade 5, Lesson 20, Volume

Lesson Focus: Find volume of composed figures

Practice Focus: Students will use knowledge about volume of rectangular prisms to find volumes of solid figures composed of two non-overlapping right rectangular prisms by breaking the figure apart and adding the volumes of the non-overlapping parts.

Objective: Students will use the formula for volume to find the volumes of combined right rectangular prisms, recognizing volume as additive.

Key Vocabulary: compose

TN Standards: 5.MD.C.5c Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real-world problems.

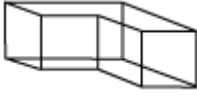
Teacher Materials:

- Board/marker
- Example of a rectangular prism such as a cube or a box
- Student Practice Packet

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 twentieth 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 using the standard formula for volume to find the volume of combined 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 20 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>Today, we're going to think about three dimensional shapes that are built using more than one rectangular prism.</p> <p>Let's start by thinking about this problem: [Display and read the following problem.]</p>  <p>My neighbor wants to build a large aquarium. The aquarium will be composed of two rectangular prisms. What information does my neighbor need in order to find the volume of the aquarium?</p> <p>What is this problem asking us? [Pause.]</p> <p>Yes, it's asking us what information the neighbor will need in order to find the volume of the aquarium.</p> <p>Let's recall what we know about volume.</p> <p>We know that volume is the measure of the amount of space a solid figure occupies. Volume is measured in cubic units. So, in this problem, the neighbor wants to know the amount of space inside the aquarium in cubic units.</p> <p>What is special about the shape of the aquarium in this problem? [Pause.]</p> <p>Yes, the aquarium will not be a rectangular prism, but it will look like it's composed of two rectangular prisms, so we can use what we know about rectangular prisms to help us with this problem.</p> <p>Hmm, I know that rectangular prisms are solid figures that have 6 faces and 12 edges. Like this box for example [Show student the model of the rectangular prism referenced in the Teacher Materials.]</p> <p>Let's think about what the problem means by <i>composed of</i> rectangular prisms. [Pause.]</p> <p>In math, we use the term <i>composed</i> to mean that something is made up of more than one component; in this case,</p>	<p>This warm-up will build on student's work with unit cubes and understanding of volume to help them recognize the volume of combined rectangular prisms as additive. By breaking down the volume of a composite figure into individual parts, students make the connection that the parts are additive, whether it is demonstrated by composed parts or by unit cubes.</p> <p>The work of this warm-up will review concepts of volume, the formula for finding volume of</p>
--	--

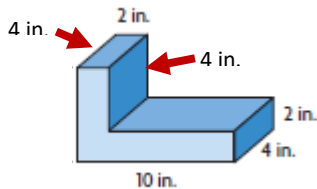
<p><i>composed</i> is referring to a figure that can be divided into more than one basic figure (the rectangular prism).</p> <p>So, what information will the neighbor need in order to find the volume of an aquarium that's composed of two rectangular prisms? [Pause.]</p> <p>Good thinking! The neighbor will need to know the dimensions, or the measures of the length, width, and height of each rectangular prism.</p> <p>You might recall the formula for finding the volume of rectangular prisms is $V = l \times w \times h$ [Display formula and point to each part as you name that they represent.] That is, Volume (V) equals the length (l) of the prism times the width (w) of the prism, times the height (h) of the prism.</p> <p>In the formula, what are we measuring when we find length times width ($l \times w$)? $V = l \times w \times h$ [Pause.]</p> <p>You're right! The length times width gives us the area of the rectangular prism's base, or this bottom layer. [Point to the base of your model.]</p> <p>In the formula, what are we measuring when we find the height? [Pause.]</p> <p>Good! The height of a rectangular prism is the distance between the base and the top layer. [Point to the height of your model.]</p> <p>Hmm, the neighbor could use the formula for finding volume to determine the volume for each of the figure's rectangular prisms, but how can the total volume of the aquarium be found? [Pause.]</p> <p>Good thinking! The neighbor can find the volume of the two rectangular prisms, and then add the two volumes together!</p> <p>Let's apply this method to find the total volume of combined rectangular prisms.</p>	<p>rectangular prisms, and understanding the concept of composite figures.</p>
<p><u>Teacher Model</u> (6 min.)</p> <p>Objective 1: Teacher will explicitly instruct and model how to break apart a composite figure that is made up of two or more</p>	<p>Objective #1:</p>

non-overlapping rectangular prisms in order to apply the formula for volume.

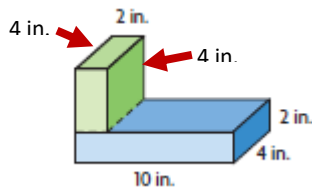
[Display and read the problem aloud.]

This is a composite figure. How can you break apart this figure into two rectangular prisms? [Pause.]

Yes, we could draw a horizontal line or a vertical line.



This diagram shows one way the figure can be broken apart. The smaller rectangular prism is shaded green, and the larger one is shaded blue. [Point to each prism.]

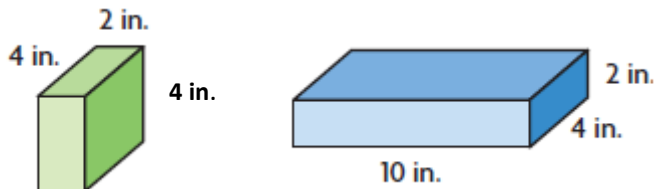


Let's look at the dimensions of this figure.

In the original figure, notice that the height on the left side is 6 inches and the height on the right side is 2 inches. [Point to the indicated component.]

We've broken the figure apart into two separate rectangular prisms. [Pause.]

[Display the following for reference.]



Now, we need to find the length, width, and height of each prism. What is the length of green prism? [Point to the indicated components and label the missing measurements as you go along.] [Pause.]

Yes, the length of the green prism is still 2 inches.

Students will listen to and observe the teacher and recognize volume as additive.

What is its width? [Point to the indicated component.]
[Pause.]

Yes, the width of the green prism is still 4 inches.
What is its height? [Pause.] **Yes, the height is also 4 inches.**

What are the dimensions of the blue prism? [Pause.]
Correct! The blue prism's length is 10 inches, its width is 4 inches, and its height is 2 inches. [Point to the edges as you mention them.]

Objective 2: Teacher will model how to apply the formula for volume to find the total volume of a composite figure, making explicit the idea that the total volume is composed of the sum of its individual parts.

We have the dimensions of both rectangular prisms, so we can use the formula to determine the volume of each.

[Write and say.]

Green prism: $V = 2 \times 4 \times 4$
 $V = 32 \text{ in}^3$

The volume of the green prism is 32 inches cubed.

[Write and say.]

Blue prism: $V = 10 \times 4 \times 2$
 $V = 80 \text{ in}^3$

The volume of the blue prism is 80 inches cubed.

Now, we need to add them together to find the total volume.
What is the sum of the two volumes? [Pause.]

Yes!

[Write and say.]

$32 \text{ in}^3 + 80 \text{ in}^3 = 112 \text{ in}^3$
 $V = 112 \text{ in}^3$

So, the volume of the composite figure is 112 cubic inches.

Objective #2:

Students will listen to and watch how to apply the formula for volume to find the total volume of a composite figure. By breaking down the volume of the composite figure into individual parts, and adding their individual volumes, students make the connection that the parts are additive.

Tying the learning together:

Great work everyone!

In the problem we just solved, we broke a composite figure into two of its parts, then added the volumes of the two parts to give us the total volume of the composite figure.

In the same way that unit cubes were added to form rectangular prisms in earlier lessons, in this lesson, rectangular prisms are combined to form composite figures.

Tying the learning together:

By breaking down the volume of a composite figure into individual parts, students make the connection that the parts are additive, whether it is demonstrated by composed parts or by unit cubes. Relating to prior work with unit cubes, the students will recognize volume as additive.

Guided Practice (10 min.)

If you have a pencil and paper, work through this problem along with me. [Write the following problem and think aloud.]

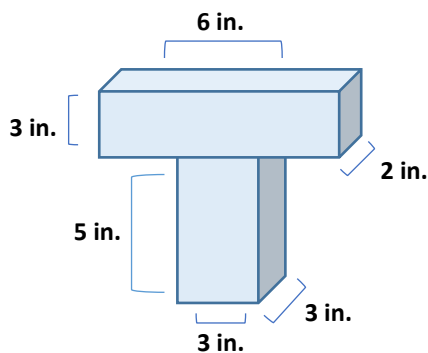
[I do.]

[Teacher thinks aloud through the process of breaking apart the combined solid figure into separate rectangular prisms and combining the volumes to find the total volume of the figure.]

[Display and read aloud.]

Look at the solid figure. To find the total volume, Miguel broke it apart into two rectangular prisms. How can he use the two prisms to find the total volume of the figure?

[Pause.] **Yes, he can decompose the figures.**



What information do we need in order to find the total volume? [Pause.]

Right, we need to decide how we want to decompose the figure into 2 rectangular prisms so that we can find the

[I do.]

Students work alongside the teacher as the teacher thinks aloud through solving problems involving the volume of 3-dimensional composite figures.

volume of each. Then, we need to know the length, width, and height of each rectangular prism. Then, we can add the 2 volumes together to get the total volume.

Let's do that together.

[Display the following and fill in the missing parts as you think aloud.]

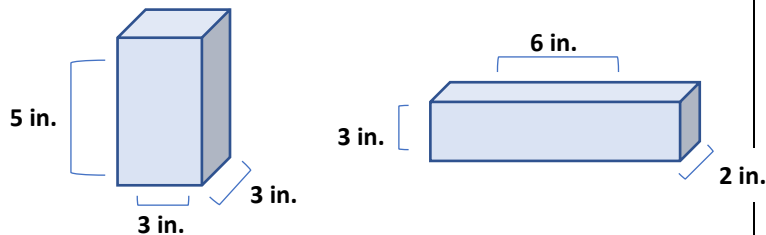
$$V = _ \times _ \times _ = _ \text{ cu ft}$$

$$V = _ \times _ \times _ = _ \text{ cu ft}$$

$$\text{Total volume} = _ + _ = _ \text{ cubic feet}$$

Looking at the composite figure, I notice that it's composed of a vertical rectangular prism and a horizontal rectangular prism. Do you see the 2 prisms I'm referring to? [Pause.] Exactly!

[Display the diagrams of decomposed figures.]



Here, we can see each prism. Let's start with the vertical prism. [Point to the prism.]

What is the length and width of this prism? [Pause.]

Yes, the length and width are 3 in. [Write this information in the blank equation.]

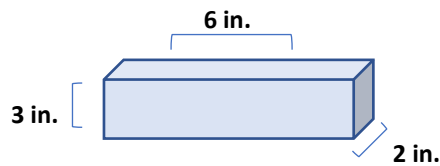
Now, what is this prism's height? [Pause.]

Great! Its height is 5 in. [Write this information in the blank equation.]

Using the formula, $V = l \times w \times h$, we can determine the volume of this rectangular prism. 3 times 3 is 9, and 9 times 5 is 45. So, the volume is 45 cubic inches.

[Point to the figure as you think aloud to indicate the components you are thinking about and fill in the blank equation.]

Now, let's look at the horizontal prism.



What is the length and width of this prism? [Pause.]

Yes, the length and width are 6in. and 2 in.

Now, what is this prism's height? [Pause.]

Great! Its height is 3 in.

Using the formula, $V = l \times w \times h$, we can determine the volume of this rectangular prism. 6 times 2 is 12, and 12 times 3 is 36. So, the volume of this prism is 36 cubic in. [Fill in the information in the equation.]

Whew! We have found the volumes of both rectangular prisms. Now, we can combine the 2 volumes to get the total volume of the composite figure.

45 cubic in + 36 cubic in = 81 cubic in. [Fill in the information in the equation.]

The total volume for the combined figure is 81 cubic in.

Great work!

[We do.]

Let's solve a similar problem together. Do you have your pencil and paper ready? [Pause.]

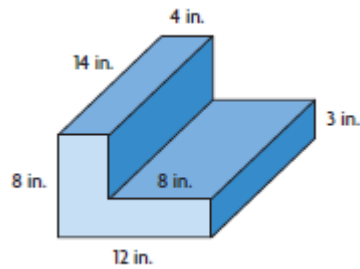
Great, here's our problem [Display the problem and read it aloud.]

As part of a wood-working project, Demetria made this figure out of wooden blocks. How much space does the figure take up?

[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.

The work of this problem connects to the learning model.



What is the problem asking us? [Pause.]

Yes, the problem wants to know how much space the figure takes up, or the volume of the figure.

How can we find the volume of this figure? [Pause.]

Good thinking! We can break the figure apart into 2 rectangular prisms.

We could divide the figure with a vertical line here [Indicate a separation along the bend of the figure.]

Now we have 2 separate rectangular prisms. What information do we need to determine the volumes? [Pause.]

Right, we need to know the length, width, and height of each rectangular prism. Then, we can combine them to get the total volume of the figure.

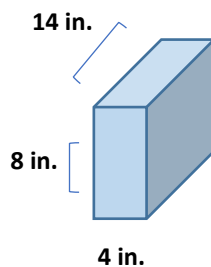
[Display the following and fill in the missing parts as you work the problem together.]

$$V = _ \times _ \times _ = _ \text{ cu ft}$$

$$V = _ \times _ \times _ = _ \text{ cu ft}$$

$$\text{Total volume} = _ + _ = _ \text{ cubic inches}$$

What are the dimensions of this taller prism? [Pause.]



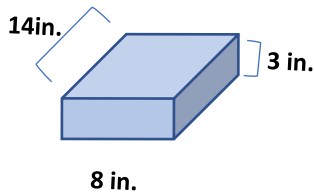
Good job! Its length and width are 4 in and 14 in, and the height is 8 in.

Now, Use the formula to find the volume of this rectangular prism. [Pause to allow students to compute.]

What is the volume for this prism? [Pause.]

Excellent! The volume is 448 cubic inches because $4 \times 14 \times 8 = 448$.

Now, what are the dimensions of the second rectangular prism? [Pause.]



Good job! Its length and width are 8 in and 14 in, and the height is 3 in.

Now, Use the formula to find the volume of this rectangular prism. [Pause to allow students to compute.]

What is the volume? [Pause.]

Excellent! The volume is 336 cubic inches because $8 \times 14 \times 3 = 336$.

How can you determine the total volume of the composite figure? [Pause.]

Yes! By combining the two volumes!

What is the total volume? [Pause to allow students to compute.]

Good job!

The volume of the combined figure is $448 + 336 = 784$ cubic inches.

[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.]

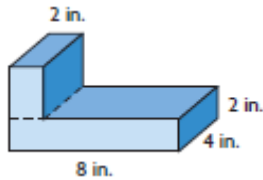
Great! Here's your problem: [Display and read aloud.]

[You do.]

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

Find the volume of the composite figure.

Johnathan made this figure out of cardboard. He wants to know how much space his figure takes up. He divided the figure into 2 rectangular prisms. Find the volume of each rectangular prism, then find the combined volume.



[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.]

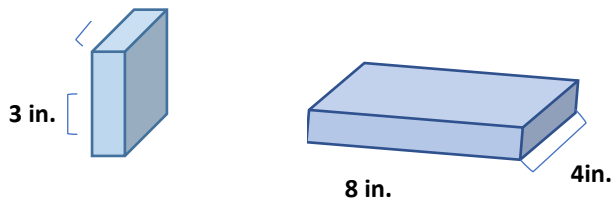
Okay, great!

[Display the following as you and the student check work together.]

Did you find the volume of the 2 rectangular prisms? [Pause.]

Good!

You might have decomposed the composite figure into 2 rectangular prisms like this. [Display the diagram.]



What is the volume of this prism? [Pause.]

Did you say 24 cubic inches? [Pause.]

Excellent! You should've multiplied $2 \times 4 \times 3$ to get 24 cubic inches.

What is the volume of the other rectangular prism? [Pause.]

Did you get 64 cubic inches? [Pause.]

You should've multiplied $8 \times 4 \times 2$ to get 64 cubic inches.

Great! What is the total volume of Johnathan's figure?

[Pause.]

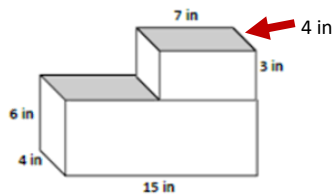
You're right! $24 + 64 = 88$. So, the total volume is 88 cubic inches.

Great work, everyone!

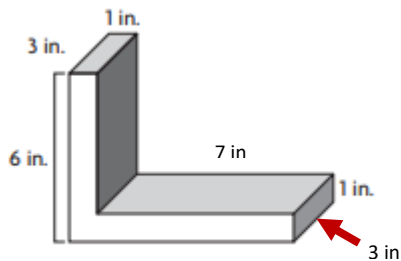
Additional Problems (if needed):

These figures were made in wood-working class. Find the total volume.

1.



$V = 444$ cubic ft



2.

$V = 39$ cubic inches

Independent Practice (1 min.)

Great work, students! Today, we used the standard formula for volume to find the volume of combined rectangular prisms. I hope you're seeing some connections between volume and multiplication. 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 a document camera or camera zooms in on student practice page.] Good luck and do your best!

Closing (1 min.)

- | | |
|---|--|
| <ul style="list-style-type: none">• Students, I enjoyed using the formula for volume to find the volumes of composite figures. Thank you for inviting me into your home. Bye! | |
|---|--|

Copyright © by Houghton Mifflin Harcourt Publishing Company. All rights reserved. Reproduced by permission of the publisher, Houghton Mifflin Harcourt Publishing Company. Content is made accessible by a Special School Closing Emergency License that is limited to the 2020 academic year and shall conclude on June 30, 2020. Use does not imply affiliation with or endorsement by the third party.