

Math: Grade 7, Lesson 20, Solving Volume Problems

Lesson Focus: This lesson will focus on various strategies to solve three dimensional volume problems

Practice Focus: Students will use various strategies to find the volume of various figures.

Objective: The objective of the lesson is to explore a variety of different strategies in order to calculate the volume of cubes and prisms.

Key Vocabulary: Volume, Cubes, and Prisms

TN Standards: 7.G.B.5

Teacher Materials

- Paper or white board
- Pen/pencil/marker
- Prepared copies of the examples (to save time)
- Student Practice Packet

Student Materials:

- Paper and a pencil, a surface to write on, possible calculator.

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 7th 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. If you don't already have the student packet for this lesson, you can find it online 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 solving for volume in various three dimensional figures. Before we get started, to participate fully in our lesson today, you will need:</p> <ul style="list-style-type: none">• Paper, a pencil, a surface to write on, the optional student packet, and an optional calculator. <p>Ok, let's begin!</p>	<p>Students get materials ready for the lesson.</p>
<p><u>Intro</u> (5 minutes)</p> <p>Can you picture a box or a cube for me? [Pause] What about a prism [Pause] If you don't know what a prism is it is ok! We will explore a variety of them today. The definition of a prism</p>	

is a solid geometric figure whose two end faces are similar, equal, and parallel rectilinear figures, and whose sides are parallelograms. [Teacher says and displays definition on the board.]

From our previous lessons we have reviewed how to calculate the area of various simple figures. Please copy down this table that contains the area formulas of these simple shapes as it will be helpful throughout the lesson. [Teacher displays table and gives students a minute to copy it onto their paper.]

Shape	Area Formula
Triangle	$A = \frac{1}{2} (base) (height)$
Square	$A = (side)^2$
Rectangle	$A = (length) (width)$
Parallelogram	$A = (base) (height)$
Circle	$A = \pi(radius)^2$

This table will be very helpful as we solve for volume of various cubes and prisms. Before we begin let's define what volume is! [Teacher will display definition and read it aloud.] Volume is the amount of space that a substance or object occupies or that is enclosed within a container. We measure volume in cubic units. [Pause] I want you to picture your box again. You got it? [Pause] Good! The amount of air that is inside of the box is known as the volume! You can also think about this as a cup of water. The cup is very close to a circular prism also known as a cylinder and the water inside would be the amount of volume that cup can hold. When naming our various prisms today the first word will be the shape of the base for instance I just called a cylinder a circular prism. That means that the base is a circle and prism means that its sides are the same and parallel. What does parallel mean? [Pause] It means that those sides will not touch.

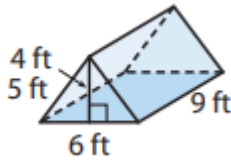
Are you ready to look at some examples? I know I am! [Pause] Here we go!

Teacher Model (8 minutes)

Objective 1: Find the volume of a triangular prism.
[Teacher reads problem aloud and displays on board.]

Objective 1: Students will calculate the volume of a triangular prism.

Bradley's tent is in the shape of a triangular prism and has the dimensions as the one shown below. How many cubic feet of space are in his tent?



In order to calculate the volume or the cubic feet of space inside of Bradley's tent or for any prism we must use the formula ***Volume = Bh*** [Teacher writes formula on the board.] where "**B**" is the area of the base of the prism and "**h**" is the height of the prism. [Teacher writes "area of base" and "height" on the board.] Please write this formula, area of base, and height on the top of your paper! [Pause]

The problem tells us that Bradley's tent is what kind of shape? [Pause] A triangular prism. Since it is a triangular prism what shape will the base of the prism be? [Pause] Right it will be a triangle! From the diagram the tent will be sitting on a rectangle however when calculating the volume the first word of what the object is tells the reader what the shape of the base is. According to our formula we need to calculate the area of the base. Use your table to find the area formula for a triangle and write it down for this problem [Pause]

The area formula for a triangle is ***Area = $\frac{1}{2} (base)(height)$*** . The base of the triangle is different from the base we are using for volume. For volume the base is the entire triangle whereas the base for area is a specific measurement. What do you think the base of the triangle is? [Pause] You got it! It's the 6 feet! [Teacher points to the 6 feet.] In order to calculate the area of the triangle we need to find the height of the triangle as well. What do you think the height of the triangle is? [Pause] Good its 4 feet! [Teacher points to the 4 feet]. Since you know the base length and the height length of the triangle can you go ahead and solve for the area? [Pause] Great! Do it on your paper and then we can compare answers. [Teacher solves for area of the triangle on the board as shown below as student does it on their paper.]

$$Area = \frac{1}{2} (base)(height)$$

$$Area = \frac{1}{2} (6 \text{ feet})(4 \text{ feet})$$

$$Area = 12 \text{ square feet}$$

Student writes down formula.

Student responds to prompts.

Student solves for area of base.

Did you get 12 square feet to be the area of the triangle?

[Pause] Great! Lets keep going to find the volume of Bradley's tent!

Recall that the formula for volume of a prism is $Volume = (B)(h)$ where B is the area of the base and h is the height of the prism. You just calculated that the area of the base is 12 square feet. What do you think the hight of the prism is?

[Pause] Got it! It is 9 feet. Maybe you can picture the tent standing on the triangle section and seeing that it would be 9 feet tall. Can you go ahead and finish solving for the volume? Remember that volume units are cubic units. You can use a calclater here if you would like! Go ahead and do this on your paper! [Teacher solves for volume on the board as shown below as student does it on their paper.]

$$Volume = (B)(h)$$

$$Volume = (12 \text{ square feet})(9 \text{ feet})$$

$$Volume = 108 \text{ cubic feet}$$

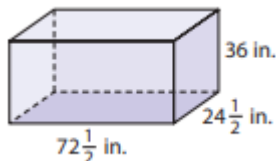
There is 108 cubic feet inside of Bradley's tent. Great job! Lets try another problem!

Objective 2: Find the volume of a Rectangular Prism.

You did a great job with that last problem! This next one is a little bit different.

[Teacher reads problem aloud and displays on board.]

A restaurant buys a freezer in the shape of a rectangular prism. The dimensions of the freezer are shown. What is the volume of the freezer?



Remember that in order to calculate the volume or the cubic feet of space inside of the freezer or for any prism we must use the formula $Volume = Bh$ [Teacher writes formula on

Student solves for volume.

Objective 2: Students will calculate the volume of a Rectangular Prism.

Student reads and listens to question.

Student copies formula.

the board.] where “B” is the area of the base of the prism and “h” is the height of the prism. [Teacher writes “area of base” and “height” on the board.]

The problem tells us that freezer is what kind of shape? [Pause] A rectangular prism. Since it is a rectangular prism what shape will the base of the prism be? [Pause] Right it will be a rectangle. According to our formula we need to calculate the area of the base. Use your table to find the area formula for a trapezoid and write it down for this problem [Pause]

The area formula for a triangle is $Area = (length)(width)$. According to the diagram what is the length and the width of the rectangle? [Pause] They are 72.5 inches and 24.5 inches [Teacher points to the 72.5 inches and 24.5 inches.] Since you know the length and the width of the rectangle, can you go ahead and solve for the area? [Pause] Great! Do it on your paper and then we can compare answers after. [Teacher solves for area of the triangle on the board as shown below as student does it on their paper.]

$$Area = (length)(width)$$

$$Area = (72.5 \text{ inches})(24.5 \text{ inches})$$

$$Area = 1776.25 \text{ square inches}$$

Did you get 1776.25 square inches to be the area of the rectangle? [Pause] Great! Lets keep going to find the volume of the freezer.

Recall that the formula for volume of a prism is $Volume = (B)(h)$ where B is the area of the base and h is the height of the prism. You just calculated that the area of the base is 1776.25 square inches. What do you think the height of the prism is? [Pause] Got it! It is 36 inches. Can you go ahead and finish solving for the volume? Remember that volume units are cubic units. You can use a calculator here if you would like! Go ahead and do this on your paper! [Teacher solves for volume on the board as shown below as student does it on their paper.]

$$Volume = (B)(h)$$

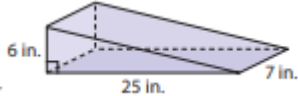
$$Volume = (1776.25 \text{ square inches})(36 \text{ inches})$$

$$Volume = 63,945 \text{ cubic inches}$$

Student answers prompts.

Student solves for area of base.

Student solves for volume.

<p>There is 63,945 cubic inches inside of the freezer. Great job! Let's try another problem!</p>	
<p><u>Guided Practice</u> (10 minutes)</p> <p>You have been doing such a great job helping me through these problems! Thank you very much for your help and answering the questions. Will you please help me with this one? [Pause] Great let's do it!</p> <p>[I do] [Teacher posts and reads problem aloud.]</p> <p>Joe build a cardboard ramp for his little brothers' toy cars. Identify the shape of the ramp and calculate the volume.</p>  <p>The problem first asks us to identify what shape the ramp is. What do you think the shape is? [Pause] Yes it is a triangular prism very good!</p> <p>What shape does that means the base of this prism is? [Pause] Excellent a triangle!</p> <p>Recall that from our previous two problems that in order to calculate the volume or the cubic feet of space inside for any prism we must use the formula $Volume = Bh$ [Teacher writes formula on the board.] where "B" is the area of the base of the prism and "h" is the height of the prism. The base is in the shape of a triangle since it is a triangular prism so in order to find the volume of this prism we need to find the area of the base. Can you tell me what the area formula for a triangle is? [Pause] You got it! It is $Area = \frac{1}{2} (base)(height)$. According to the diagram what is the distance for the base of the triangle? [Pause] Right it is the 25 inches along the bottom of the triangle. What is the height of the triangle? [Pause] Perfect! It is the 6 inches along the left hand side of the diagram. Go ahead and calculate the area of the triangle! [Teacher solves for area on the board as shown below as student does it on their paper].</p> $Area = \frac{1}{2} (base)(height)$	<p>Student reads and listens to problem while thinking of possible strategies to use to solve.</p> <p>Student will respond to prompts.</p> <p>Student solves for area of base.</p>

<p style="text-align: center;"> $Area = \frac{1}{2} (25 \text{ inches})(6 \text{ inches})$ $Area = 75 \text{ square inches}$ </p> <p> Did you get 75 square inches for the area of the triangle? [Pause] Great! That is perfect! Now all that is left if find the volume of the ramp. According to the diagram what do you believe is the height of the prism? [Pause] Excellent! It is the 7 inches along the right side of the diagram. Finish finding solving for the volume using the volume formula that was mentioned at the top of your page! You can use your calculator if you would like! [Teacher solves for volume on the board as shown below as student does it on their paper.] </p> <p style="text-align: center;"> $Volume = (B)(h)$ $Volume = (75 \text{ square inches})(7 \text{ inches})$ $Volume = 525 \text{ cubic inches}$ </p> <p> The volume of the ramp is 525 cubic inches! Great work! You are really starting to get the hang of this! Let's do another! </p> <p> [We do] [Teacher posts and reads aloud the problem.] </p> <p> Alex made a sketch for a homemade soccer goal he plans to build. The goal will be in the shape of a triangular prism. The legs of the right triangles at the sides of his goal measure 4 feet and 8 feet. And the opening along the front is 24 feet. How much space is contained within this goal? [Pause] </p> <p> I am going to give you a few seconds to think about and reread the problem so that you have all the information in you head before we continue. [Pause] </p> <p> Are you ready? [Pause] Great! Let's figure out this problem! </p> <p> What shape does the problem say that the goal will be in? [Pause] Yes it says it will be a triangular prism. What shape does that mean the base of the prism will be? [Pause] Right again! It will be a triagle. Continue to read the problem and see if you can figure out what the dimensions of the triangle are. [Pause] What did you find? [Pause] Exactly. The base of the triangle will be 4 feet in length and the height of the triangle will be 8 feet in length. Since you are calculating the volume of a prism what two pieces of information will you </p>	<p>Student calculates volume.</p> <p>Student reads and listens to questions and thinks of possible strategies to use.</p> <p>Student answers prompts throughout the question.</p>
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need? [Pause] You need the area of the base and the height of the prism because those are the two pieces of the formula. I am going to give you a minute to pick out the equation you need to calculate the area of the base and then to solve for the area of the base! You can do it! [Pause for a minute.]

The area formula for a triangle is $Area = \frac{1}{2} (base)(height)$. You have found that the dimensions of the triangular base are 4 feet and 8 feet. Here is how to calculate the area of the triangle. [Teacher solves for area on the board as shown below as student does it on their paper.]

$$Area = \frac{1}{2} (base)(height)$$

$$Area = \frac{1}{2} (4 \text{ feet})(8 \text{ feet})$$

$$Area = 16 \text{ square feet}$$

Did you get 16 square feet to be the area of the triangle? [Pause] That is awesome! Returning to the problem are you able to find how tall the prism will be? [Pause] You got it! It will be 24 feet tall. Can you go ahead and finish finding the volume of the goal? [Pause] Go ahead I believe in you! [Pause for roughly 30 seconds.]

Because the area of the base is 16 square feet and the height of the prism is 24 feet. We have the two pieces of information to substitute into the formula. [Teacher solves for volume on the board as shown below.]

$$Volume = (B)(h)$$

$$Volume = (16 \text{ square feet})(24 \text{ feet})$$

$$Volume = 384 \text{ cubic feet}$$

The volume of Alex's goal will be 384 cubic feet. Great job! Here is one for you to try!

[You do]

[Teacher reads problem and puts it up on the board.]

A company is designing a juice box. The box is in the shape of a rectangular prism. The base of the box is 6.5 inches by 2.5 inches, and the box is 4 inches high. What is the total volume of juice that the box can hold?

Student writes down equations needed.

Student solves for area of base.

Student calculates volume.

Student reads and listens to questions and thinks of possible strategies to use.

Go ahead and reread the problem. [Pause] I am going to let you work on this problem for about two minutes to get as far as you can in the solving process and then I will come back and see how you did! Ready? Go! [Pause for about two minutes.]

Excellent work! Because the problem tells you that the box will be in the shape of a rectangular prism what shape did you say the base of the box would be? [Pause] A rectangle good! What equation did you use in order to find the area of base? [Pause] $Area = (length)(width)$ is right! Check your work from what is on the board and see if you agree! [Teacher displays work below of calculating the area of the base and pauses.]

$$Area = (length)(width)$$

$$Area = (6.5 \text{ inches})(2.5 \text{ inches})$$

$$Area = 16.26 \text{ square inches}$$

Does your work look similar to mine? [Pause] Great! From the problem it says that the base of the box is 6.5 inches by 2.5 inches.

In order to find the volume what equation did you use? [Pause] $Volume = (B)(h)$ is correct where B is the area of the base and h is the height of the prism. What did you find to be the height of the prism? [Pause] From the problem it says that the box will have a height of 4 inches which would be the height of the prism. Check your work with the work on the board and see if you agree! [Teacher displays work below of calculating the volume and pauses.]

$$Volume = (B)(h)$$

$$Volume = (16.25 \text{ square inches})(4 \text{ inches})$$

$$Volume = 65 \text{ cubic inches}$$

From the equation it seems that the box would have 65 cubic inches of volume. Is that what you calculated? [Pause] Great! That means that this box could hold 65 cubic inches worth of juice. I am so proud of you! You are doing such a good job!

Additional problem if needed:

Student answers prompts throughout the problem.

Student compares work to theirs.

Student compares work to theirs.

PBS Lesson Series

<p>A student wrote this statement; “A triangular prism has a height of 15 inches and a base of 20 square inches. The volume of the prism is 300 square inches.” Identify the correct error.</p>	
<p><u>Independent Practice</u> (1 min)</p> <p>Great work, 7th grade! Today we worked on solving for volume in triangular and trapezoidal prisms. 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!</p>	
<p><u>Closing</u> (1 min)</p> <p>I enjoyed reviewing finding unit rates with ratios of fractions, and use them to solve multi-step problems 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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