

LESSON 2

Objective

Find the volume of a rectangular solid.

Common Core State Standards

- **5.MD.3a** A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.
- **5.MD.3b** A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units.
- **5.MD.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.
- **5.MD.5a** Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.
- **5.MD.5b** Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.

Measurement and Data

Volume of a Rectangular Solid

Students explore the volume of a rectangular solid by constructing a model out of cubic units. By counting units, students build an understanding of volume and visualize the connection between volume and dimensions. With this understanding, students can develop formulas for volume and are prepared to consider the volumes of other solids.

Try It!

Perform the Try It! activity on the next page.

Talk About It

Discuss the Try It! activity.

- **Ask:** *How is a cubic unit different from a square unit?* Have students use a Snap Cube® to demonstrate the difference.
- **Ask:** *How can you determine the number of cubes in the rectangular solid by looking at the completed model?*
- **Say:** *You can calculate the volume of a rectangular solid by finding the area of the solid’s base and multiplying this by the solid’s height.* **Ask:** *How do you write the formula represented by this method?* Guide students to write $V = B \times h$. **Ask:** *How do you find the area of the base?* Students should know to multiply length by width.

Solve It

Reread the problem with students. Have them talk about the two ways of writing the formula for the volume of the freezer. Guide them to see how the formulas represent different ways of visualizing the same thing, and ask them to write a paragraph about what they have learned.

More Ideas

For other ways to teach about volume of rectangular solids—

- Give pairs of students 48 Snap Cubes or Centimeter Cubes and have them build five different rectangular solids with a volume of 48 cubic units. Have them record and compare the dimensions of the solids.
- Give pairs of students the 2 cubes and the 2 rectangular prisms from the Relational GeoSolids® set and have them estimate the volumes of the solids and investigate the relationship between volume and side lengths.

Formative Assessment

Have students try the following problem.

Construction workers dug a hole that measures 5 meters long by 4 meters wide by 3 meters deep. What is the volume of the hole?

- A. 12 cubic meters B. 27 cubic meters C. 60 cubic meters D. 94 cubic meters

Try It! 30 Minutes | Groups of 3

Here is a problem about the volume of a rectangular solid.

Mr. Adams bought a freezer. The freezer is rectangular and the space inside it measures 3 feet long by 2 feet wide by 5 feet high. What is the volume of the space inside the freezer? Write a general formula for this volume that could be used for any length, width, and height.

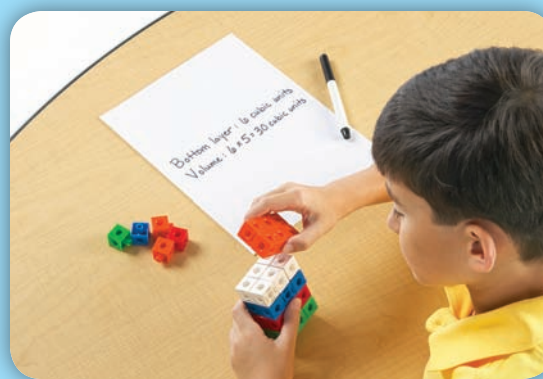
Introduce the problem. Then have students do the activity to solve the problem. Distribute Snap Cubes, paper, and pencils to students. **Say:** *Volume is a three-dimensional measure and is therefore expressed in cubic units.*

Materials

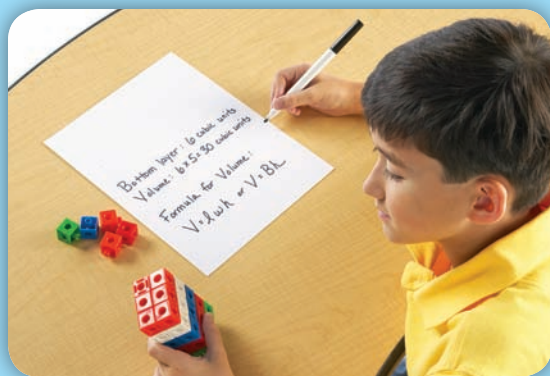
- Snap Cubes® (30 per group)
- paper (1 sheet per group)
- pencils (1 per group)



1. Say: *Using cubes, build a 3-by-2 rectangle to represent the bottom layer of space inside the freezer.* **Ask:** *How many cubic units are in this layer of cubes?* Have students count cubes or multiply to find the number of cubic units.



2. Say: *Stack additional 3-by-2 layers on top of the first layer to make a solid that is five layers tall. The solid model represents the space inside the freezer.* **Ask:** *How many cubic units are in the model?* Guide students to multiply the number of cubic units in each layer by the number of layers. Have them record their results.



3. Say: *You can multiply length by width by height to find the volume.* Have students confirm that multiplying length by width by height produces the same answer. **Say:** *Write a formula for volume.* Help students write the formula.

Look Out!

Some students might not see the connection between the different forms of the volume formula: $V = lwh$ and $V = Bh$. Help students see that multiplying length by width is the same as calculating the area of the base. Reinforce this idea by presenting a table like the following and having students extend the table for additional layers.

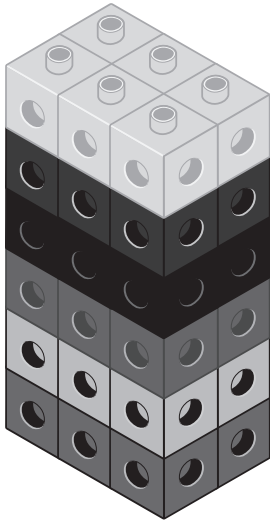
Number of layers	Cubic units	$V = lwh$	$V = Bh$
one	6	$3 \times 2 \times 1 = 6$	$6 \times 1 = 6$
two	12	$3 \times 2 \times 2 = 12$	$6 \times 2 = 12$



Use Snap Cubes to model the rectangular solid. Find the volume.

(Check students' work.)

1.



What is the length? 3 units

What is the width? 2 units

What is the height? 6 units

What is the volume? 36 cubic units

Using Snap Cubes, model the solid with the given dimensions. Sketch the model. Find the volume.

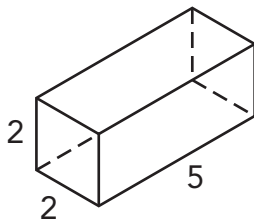
2. length: 7 units, width: 5 units, height: 2 units

(Check students' models.)

70 cubic units

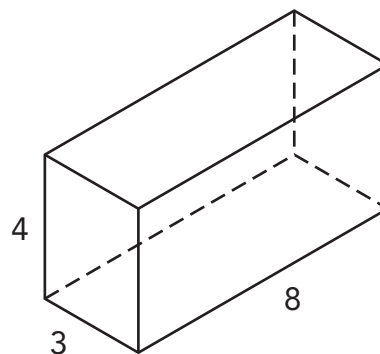
Find the volume of each rectangular solid.

3.



20 cubic units

4.



96 cubic units

5. length: 8 units
width: 3 units
height: 5 units

120 cubic units

Answer Key

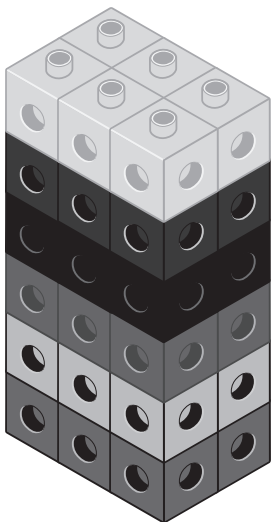
Challenge! Explain why the volume formulas $V = l \times w \times h$ and $V = B \times h$ give the same results. (B represents the area of the base.)

Challenge: (Sample) The formula for area of the base is $l \times w$. Each layer or unit of the height that makes up the solid gets multiplied by that area.

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Use Snap Cubes to model the rectangular solid. Find the volume.

1.



What is the length? _____

What is the width? _____

What is the height? _____

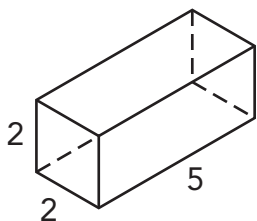
What is the volume? _____

Using Snap Cubes, model the solid with the given dimensions. Sketch the model. Find the volume.

2. length: 7 units, width: 5 units, height: 2 units

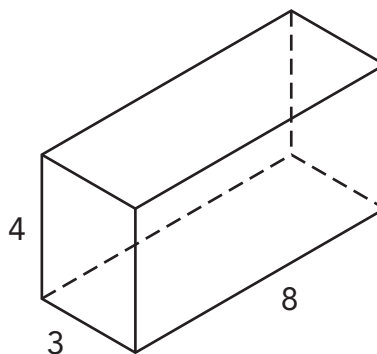
Find the volume of each rectangular solid.

3.



5. length: 8 units
width: 3 units
height: 5 units

4.



Name _____

Challenge! Explain why the volume formulas $V = l \times w \times h$ and $V = B \times h$ give the same results. (B represents the area of the base.)

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