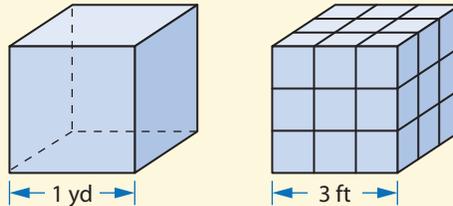


# Volume

## Use What You Know

You know how to find the volume of a prism whose dimensions are whole numbers. In this lesson, you will find the volume when the dimensions include fractions. Take a look at this problem.

Each edge of a cube is 1 yard long. The cube is going to be filled with small cubes. Each small cube has edges that are 1 foot long. (Remember that there are 3 feet in 1 yard.)



What is the volume, in cubic yards, of one of the small cubes?

**Use the math you already know to solve this problem.**

- Write the volume of the large cube in cubic yards. \_\_\_\_\_
- How many small cubes are needed to fill the large cube? \_\_\_\_\_
- Explain how to find the volume of one of the small cubes in cubic yards. What is the volume, in cubic yards, of each small cube?

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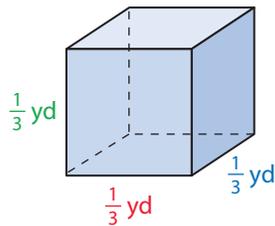
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## ► Find Out More

Prisms in everyday life may have dimensions that are fractional. The **length** ( $\ell$ ), **width** ( $w$ ), and **height** ( $h$ ) of the small cubes on the previous page are all  $\frac{1}{3}$  yard.



You can use the formulas  $V = \ell wh$  or  $V = Bh$  to find the volume of any rectangular prism, whether the side lengths are whole numbers, fractions, or decimals.

$$\begin{aligned} V &= \ell \times w \times h \\ &= \frac{1}{3} \text{ yd} \cdot \frac{1}{3} \text{ yd} \cdot \frac{1}{3} \text{ yd} \\ &= \frac{1 \cdot 1 \cdot 1}{3 \cdot 3 \cdot 3} \text{ yd}^3 \\ &= \frac{1}{27} \text{ cubic yard, or yd}^3 \end{aligned}$$

## ► Reflect

- 1 Explain how to find the volume of a cube whose edge length is  $\frac{1}{4}$  yd. Then find the volume of such a cube.

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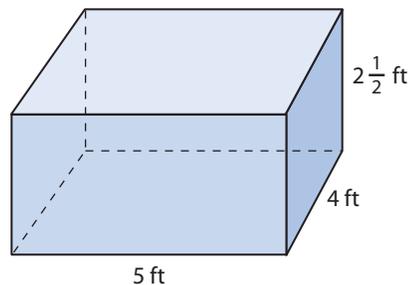
**Learn About**  **Fractional Dimensions**

Read the problem below. Then explore different ways to find the volume of a rectangular prism whose dimensions are not all whole numbers.

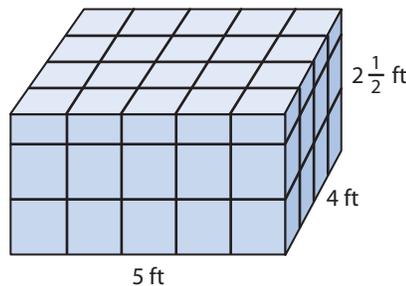
A child's sandbox is 5 feet wide, 4 feet long, and 3 feet deep. Grace fills the sandbox so that the sand is  $2\frac{1}{2}$  feet deep. What is the volume of the sand in the box?

**Picture It** You can make a sketch of the sandbox and label it with the given information.

The sand is  $2\frac{1}{2}$  feet deep, so  $h = 2\frac{1}{2}$ .



**Model It** You can model the volume of the sand with 1-foot unit cubes.



**Connect It** Now you can use what you know about volume to find the volume of sand in the sandbox.

**2** Look at *Model It*. How many cubes are in the bottom layer? Explain your reasoning.

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How many cubes in the next layer? \_\_\_\_\_

**3** How many whole cubes can you make with the blocks in the third layer? Explain.

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**4** Explain how to use your answers to problems 2 and 3 to find the total volume of sand.

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**5** Use the formula  $V = \ell wh$  to find the total volume of the sand.

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**6** Describe how to find the volume of a rectangular prism when the dimensions include fractions.

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**Try It** Use what you learned about finding the volume of a prism to solve these problems. Show your work on a separate sheet of paper.

**7** The length of a box of colored pencils is 6 inches, the width is 4 inches, and the height is  $\frac{3}{8}$  inch. What is the volume of the box? \_\_\_\_\_

**8** The width of a recycling bin is  $\frac{3}{4}$  foot, the length is 1 foot, and the height is  $1\frac{1}{2}$  feet.

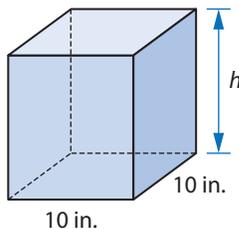
What is the volume of the recycling bin? \_\_\_\_\_

**Learn About**  **Finding an Unknown Dimension**

Read the problem below. Then explore different ways to find one dimension of a rectangular prism whose dimensions are not all whole numbers.

The volume of water in an aquarium is 1,150 cubic inches. The base of the aquarium is a square with edge length 10 inches. What is the height of the water in the aquarium?

**Picture It** You can make a sketch of the water in the aquarium and label it with the given information.



**Model It** You can model the volume of water with the equation  $V = \ell \times w \times h$  or  $V = B \times h$ .

$$V = \ell \times w \times h$$

$$1,150 = 10 \times 10 \times h$$

In the formula  $V = Bh$ ,  $B$  represents the area of the base of the prism. To find the area of the base, multiply 10 inches by 10 inches to get 100 square inches.

$$V = B \times h$$

$$1,150 = 100 \times h$$

**Connect It** Now you can use what you know about volume to find the height of the water in the aquarium.

9 Explain how the formulas  $V = \ell wh$  and  $V = Bh$  are alike.

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10 Describe how to solve the equation  $1,150 = 100 \times h$  for  $h$ .

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11 Find the height of the water in the aquarium.

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12 Suppose you know that the height of the water in the aquarium is  $11\frac{1}{2}$  inches, the length is 10 inches, and the volume is 1,150 cubic inches. Write the equation you might use to find the width of the aquarium.

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13 Look back at how you found the volume of the sand in the sandbox. Compare finding the volume with finding the height of the water on these pages. How are the two processes different? \_\_\_\_\_

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**Try It** Use what you learned about finding a missing dimension of a rectangular prism to solve these problems. Show your work on a separate sheet of paper.

14 A product design team is working on a new drink box, which will hold 225 cubic centimeters of juice. The box is 12.5 centimeters high and 4.5 centimeters long. What is the width of the box? \_\_\_\_\_

15 Eduardo has 27 cubic feet of wood chips to use for a new path in a garden. The chips must be 6 inches deep, and the path is 3 feet wide. How long can the path be? (Remember that there are 12 inches in 1 foot.) \_\_\_\_\_

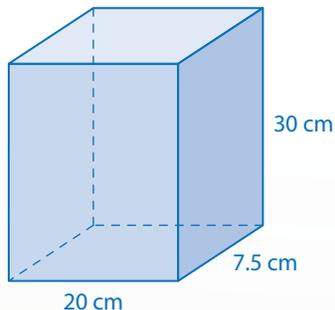
**Practice**  **Finding Volume**

Study the example below. Then solve problems 16–18.

**Example**

A box of breakfast cereal is 20 centimeters long, 7.5 centimeters wide, and 30 centimeters high. What is the volume of the box?

**Look at how you can use a drawing to display the given information.**



$$\begin{aligned} V &= \ell \times w \times h \\ &= 20 \times 7.5 \times 30 \\ &= 4,500 \end{aligned}$$

**Solution** 4,500 cubic centimeters



The student multiplied the length, width, and height to find the volume of the box.

 **Pair/Share**

How could you estimate the volume?

- 16** The base of a jewelry box is a square with a side length of  $5\frac{1}{2}$  inches.

The box is 2 inches high. What is the volume of the box?

**Show your work.**



Sketching the prism is a good way to organize the given information.

 **Pair/Share**

If the base is a square, which two dimensions do you know?

**Solution** \_\_\_\_\_

- 17 A rectangular swimming pool is 10 meters long and 4.5 meters wide. If the volume of the water in the pool is 72 cubic meters, how deep is the water?

**Show your work.**



What are you trying to find in this problem?

**Solution** \_\_\_\_\_

 **Pair/Share**

How is this problem different from the previous two problems?

- 18 The volume of a rectangular prism is 10 cubic feet. What could the dimensions of the prism be?

- A 100 ft,  $\frac{1}{2}$  ft,  $\frac{1}{2}$  ft
- B 10 ft,  $\frac{1}{2}$  ft, 2 ft
- C 5 ft,  $2\frac{1}{2}$  ft,  $2\frac{1}{2}$  ft
- D 10 ft, 10 ft,  $\frac{1}{2}$  ft



Will the formula for volume help answer the question?

Carla chose **C** as the correct answer. How did she get that answer?

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 **Pair/Share**

Explain why Carla's answer doesn't make sense.

Solve the problems.

1 What is the volume of a cube with edge length  $\frac{2}{3}$  yard?

A  $\frac{4}{9}$  yd<sup>3</sup>

B  $\frac{8}{3}$  yd<sup>3</sup>

C  $\frac{8}{27}$  yd<sup>3</sup>

D 2 yd<sup>3</sup>

2 The volume of a box of soup broth is 972 cubic centimeters. The box is 20 centimeters high and 10.8 centimeters long. How wide is the box?

A 90 cm

B 4.5 cm

C 216 cm

D 48.6 cm

3 The cargo hold of a truck is a rectangular prism measuring 18 feet by 13.5 feet by 9 feet. The driver needs to figure out how many storage boxes he can load. Choose *True* or *False* for each statement.

a. The truck driver can load up to 54 boxes with dimensions 3 ft by 3 ft by 4.5 ft.

True  False

b. The truck driver can load up to 81 boxes with dimensions 3 ft by 3 ft by 3 ft.

True  False

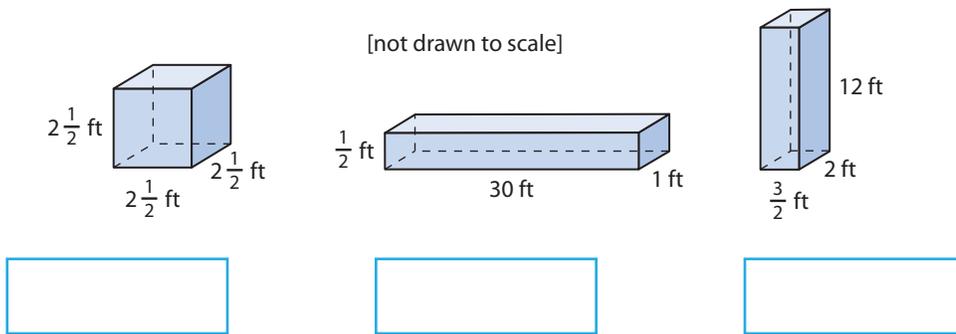
c. The truck driver can load up to 24 boxes with dimensions 4.5 ft by 4.5 ft by 4.5 ft.

True  False

d. The truck driver can load up to 12 boxes with dimensions 9 ft by 4.5 ft by 4.5 ft.

True  False

- 4 The three shipping boxes below have different volumes and are to be labeled Large, Medium, and Small based on their volumes. Write the appropriate label, Large, Medium, or Small, under each of the boxes.



- 5 The volume of a rectangular prism is 12 cubic inches. One of the dimensions of the prism is a fraction. What could the dimensions of the prism be? Give two possible answers.

**Show your work.**

**Answer** \_\_\_\_\_

- 6 A building supply company sells sand by the cubic foot and by the cubic yard. The price of one cubic yard of sand is \$33.75. What do you think the price of one cubic foot of sand should be? Explain your answer.

**Show your work.**

**Answer** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Self Check** Go back and see what you can check off on the Self Check on page 225.