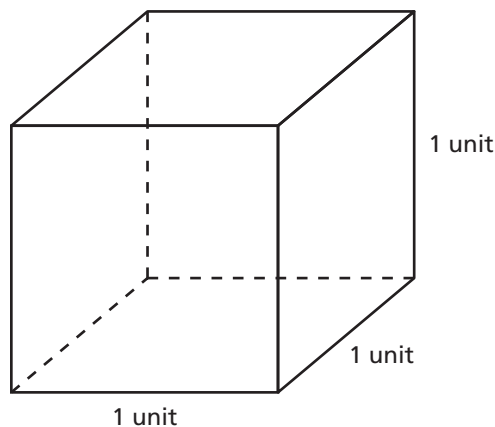


## 8.4 Volumes of Rectangular Prisms

**Essential Question** How can you find the volume of a rectangular prism with fractional edge lengths?

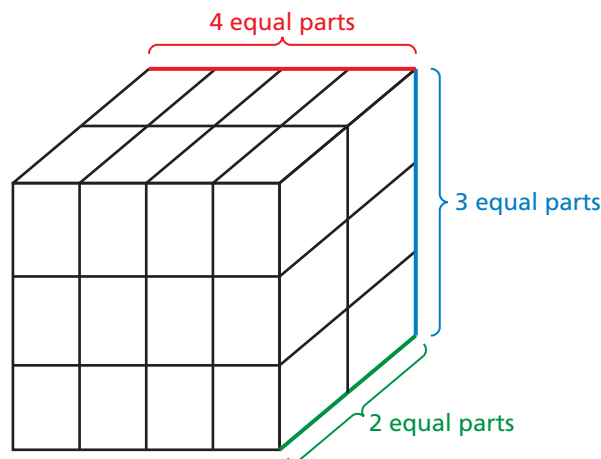
Recall that the **volume** of a three-dimensional figure is a measure of the amount of space that it occupies. Volume is measured in *cubic units*.

A *unit cube* is a cube with an edge length of 1 unit.



### 1 ACTIVITY: Using a Unit Cube

Work with a partner. The parallel edges of the unit cube have been divided into 2, 3, and 4 equal parts to create smaller rectangular prisms that are identical.



#### Geometry

In this lesson, you will

- find the volume of prisms with fractional edge lengths by using models.
- find the volume of prisms by using formulas.

Learning Standard  
6.G.2

- Draw one of these identical prisms and label its dimensions.
- What fraction of the volume of the unit cube does one of these identical prisms represent? Use this value to find the volume of one of the identical prisms. Explain your reasoning.

## 2 ACTIVITY: Finding the Volume of a Rectangular Prism

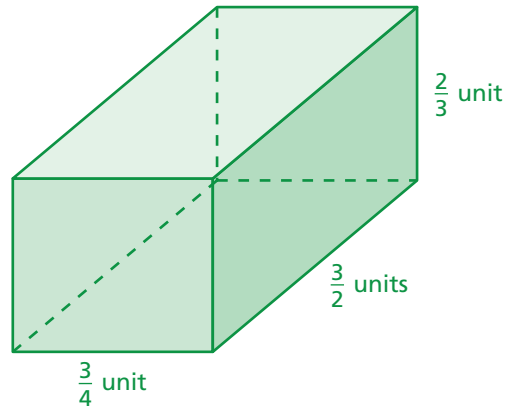
Work with a partner.

- a. How many of the identical prisms in Activity 1(a) does it take to fill the rectangular prism below? Support your answer with a drawing.

### Math Practice 4

#### Analyze Relationships

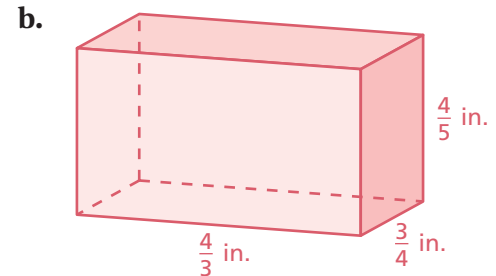
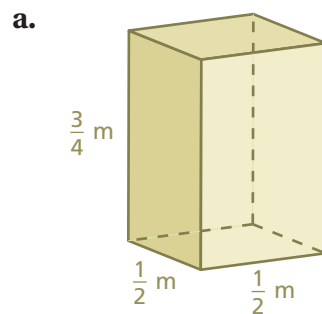
What is the relationship between the solid shown here and the solid in the previous activity?



- b. Use the volume of one of the identical prisms in Activity 1(a) to find the volume of the rectangular prism above. Explain your reasoning.

## 3 ACTIVITY: Finding the Volumes of Rectangular Prisms

Work with a partner. Explain how you can use the procedure in Activities 1 and 2 to find the volume of each rectangular prism. Then find the volume of each prism.



### What Is Your Answer?

- You have used the formulas  $V = Bh$  and  $V = \ell wh$  to find the volume  $V$  of a rectangular prism with whole number edge lengths. Do you think the formulas work for rectangular prisms with fractional edge lengths? Give examples with your answer.
- IN YOUR OWN WORDS** How can you find the volume of a rectangular prism with fractional edge lengths?

### Practice

Use what you learned about the volume of a rectangular prism to complete Exercises 4–6 on page 378.

## Key Vocabulary

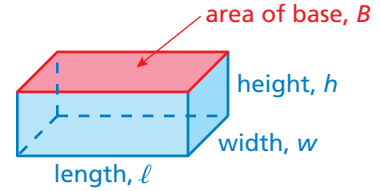
volume, p. 374

## Key Idea

### Volume of a Rectangular Prism

**Words** The volume  $V$  of a rectangular prism is the product of the area of the base and the height of the prism.

**Algebra**  $V = Bh$  or  $V = \ell wh$

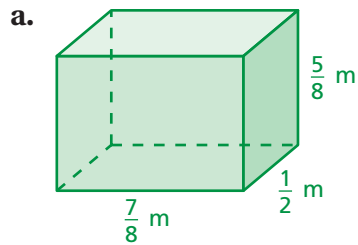


## EXAMPLE 1 Finding Volumes of Rectangular Prisms

Find the volume of each prism.

### Study Tip

In Example 1(b), the rectangular prism is a cube. You can use the formula  $V = s^3$  to find the volume  $V$  of a cube with an edge length of  $s$ .



$$V = \ell wh$$

Write formula.

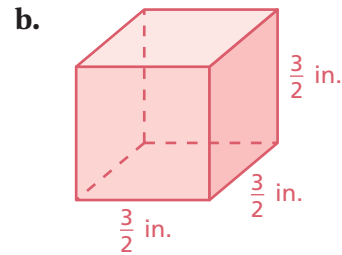
$$= \frac{7}{8} \left( \frac{1}{2} \right) \left( \frac{5}{8} \right)$$

Substitute values.

$$= \frac{35}{128}$$

Multiply.

So, the volume is  $\frac{35}{128}$  cubic meter.



$$V = \ell wh$$

$$= \frac{3}{2} \left( \frac{3}{2} \right) \left( \frac{3}{2} \right)$$

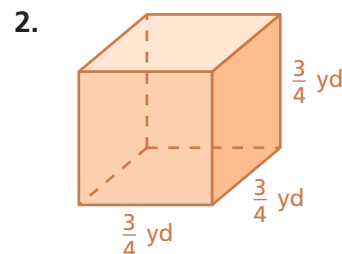
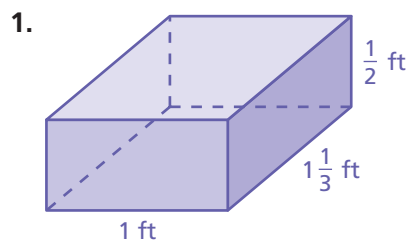
$$= \frac{27}{8}$$

$$= 3\frac{3}{8}$$

So, the volume is  $3\frac{3}{8}$  cubic inches.

## On Your Own

Find the volume of the prism.



Now You're Ready  
Exercises 4–9

## EXAMPLE 2 Using the Volume of a Rectangular Prism

One cubic foot of dirt weighs about 70 pounds. How many pounds of dirt can the dump truck haul when it is full?



Find the volume of dirt that the dump truck can haul when it is full.

$$\begin{aligned} V &= \ell wh && \text{Write formula for volume.} \\ &= 17(8)\left(4\frac{3}{4}\right) && \text{Substitute values.} \\ &= 646 && \text{Multiply.} \end{aligned}$$

So, the dump truck can haul 646 cubic feet of dirt when it is full. To find the weight of the dirt, multiply by  $\frac{70 \text{ lb}}{1 \text{ ft}^3}$ .

$$646 \cancel{\text{ft}^3} \times \frac{70 \text{ lb}}{1 \cancel{\text{ft}^3}} = 45,220 \text{ lb}$$

∴ The dump truck can haul about 45,220 pounds of dirt when it is full.

## EXAMPLE 3 Finding a Missing Dimension of a Rectangular Prism



$$\text{Volume} = 1792 \text{ in.}^3$$

Write and solve an equation to find the height of the computer tower.

$$\begin{aligned} V &= \ell wh && \text{Write formula for volume.} \\ 1792 &= 16(7)h && \text{Substitute values.} \\ 1792 &= 112h && \text{Simplify.} \\ \frac{1792}{112} &= \frac{112h}{112} && \text{Division Property of Equality} \\ 16 &= h && \text{Simplify.} \end{aligned}$$

∴ So, the height of the computer tower is 16 inches.

### On Your Own

3. **WHAT IF?** In Example 2, the length of the dump truck is 20 feet. How many pounds of dirt can the dump truck haul when it is full?

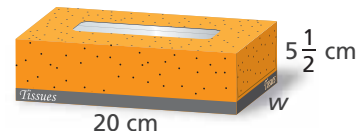
**Now You're Ready**  
Exercises 10–12

Write and solve an equation to find the missing dimension of the prism.

4. Volume = 72 in.<sup>3</sup>



5. Volume = 1375 cm<sup>3</sup>



# 8.4 Exercises

## Vocabulary and Concept Check

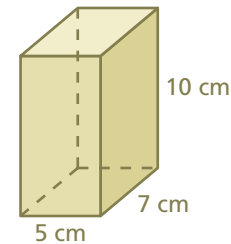
- CRITICAL THINKING** Explain how volume and surface area are different.
- REASONING** Will the formulas for volume work for rectangular prisms with decimal edge lengths? Explain.
- DIFFERENT WORDS, SAME QUESTION** Which is different? Find “both” answers.

How much does it take to fill the rectangular prism?

What is the capacity of the rectangular prism?

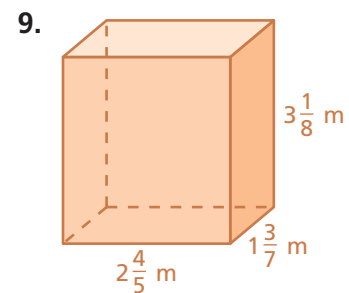
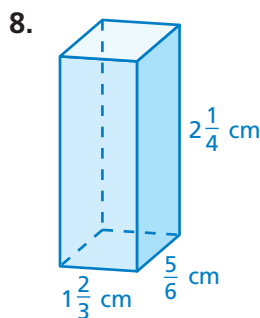
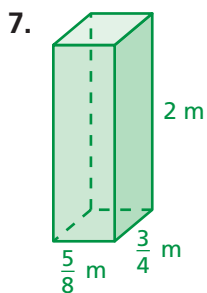
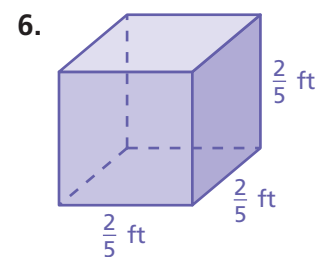
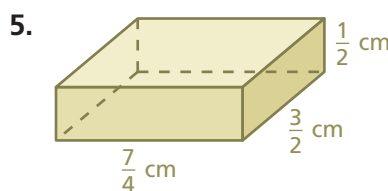
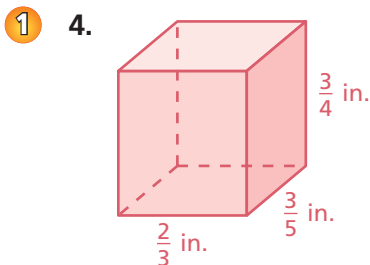
How much does it take to cover the rectangular prism?

How much does the rectangular prism contain?



## Practice and Problem Solving

Find the volume of the prism.

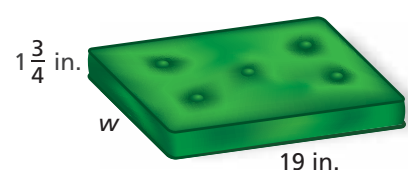
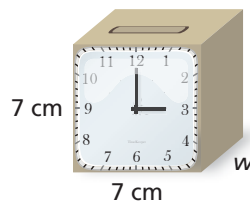
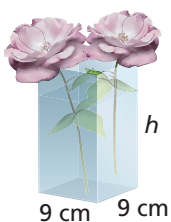


Write and solve an equation to find the missing dimension of the prism.

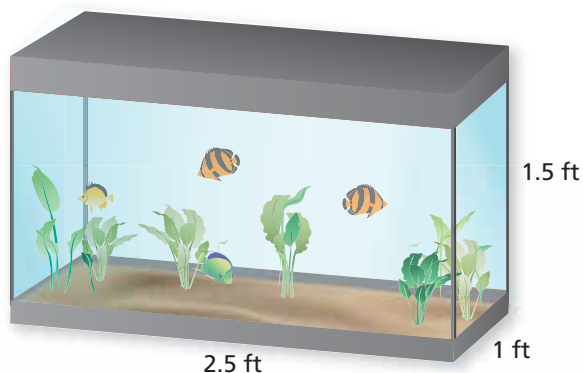
3 10. Volume =  $1620 \text{ cm}^3$

11. Volume =  $220.5 \text{ cm}^3$

12. Volume =  $532 \text{ in.}^3$



13. **FISH TANK** One cubic foot of water weighs about 62.4 pounds. How many pounds of water can the fish tank hold when it is full?



14. **CUBE** How many  $\frac{3}{4}$ -centimeter cubes do you need to create a cube with an edge length of 12 centimeters?

15. **REASONING** How many 1-inch cubes do you need to fill a cube that has an edge length of 1 foot? How can this result help you convert a volume from cubic inches to cubic feet? from cubic feet to cubic inches?

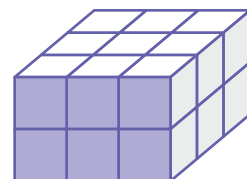


16. **FOOD STORAGE**

- Estimate the amount of casserole left in the dish.
- Will the casserole fit in the storage container? Explain your reasoning.



17. **PROBLEM SOLVING** The area of the shaded face is 96 square centimeters. What is the volume of the rectangular prism?



18. **Project** You have 1400 square feet of boards to use for a new tree house.
- Design a tree house that has a volume of at least 250 cubic feet. Include sketches of your tree house.
  - Are your dimensions reasonable? Explain your reasoning.



**Fair Game Review** What you learned in previous grades & lessons

Tell whether the given value is a solution of the equation. (Section 7.2)

19.  $x + 17 = 24$ ;  $x = 7$

20.  $\frac{x}{5} = 6$ ;  $x = 35$

21.  $x - 19 = 42$ ;  $x = 21$

22. **MULTIPLE CHOICE** Which set of integers is ordered from least to greatest? (Section 6.2)

(A)  $-1, 3, -5, -8, 12$

(B)  $-1, 3, -5, -8, 12$

(C)  $-4, -2, 1, 7, 10$

(D)  $-14, -9, 6, -4, 2$