Volume of Rectangular Prisms

| BEFORE	Now	WHY?
You found the surface area of rectangular prisms.	You'll find the volume of rectangular prisms.	So you can find the cost to fill a window box, as in Ex. 19.

In the Real World

Word Watch

volume, p. 607

Aquarium An aquarium shaped like a rectangular prism has a length of 120 centimeters, a width of 60 centimeters, and a height of 100 centimeters. How much water is needed to fill the aquarium?
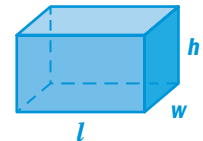
The **volume** of a solid is the amount of space it contains. Volume is measured in cubic units, such as cubic feet (ft^3) and cubic meters (m^3).
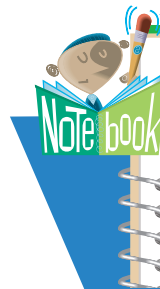
Volume of a Rectangular Prism

Words The volume V of a rectangular prism is the product of the length, width, and height.

Algebra $V = lwh$

EXAMPLE 1 Volume of a Rectangular Prism

To find the amount of water needed to fill the aquarium described above, find the volume of the aquarium.

$V = lwh$ **Write formula for volume of a rectangular prism.**

$\quad = (120)(60)(100)$ **Substitute 120 for l, 60 for w, and 100 for h.**
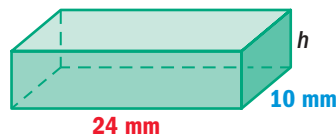
$\quad = 720{,}000$ **Multiply.**

ANSWER You need 720,000 cubic centimeters of water to fill the aquarium.

Your turn now Find the volume of the rectangular prism.

1. 10 in., 16 in., 6 in.

2. 6 ft, 4 ft, 5 ft

3. 2 m, 3.5 m, 1 m
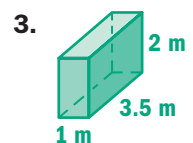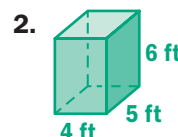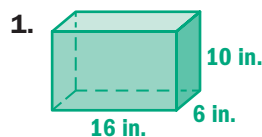
EXAMPLE **2** **Finding the Height of a Rectangular Prism**

xy The rectangular prism shown has a volume of **1440 cubic millimeters.** Find the prism's height.

h

10 mm

24 mm

$V = lwh$	Write formula for volume of a rectangular prism.
$1440 = (24)(10)h$	Substitute 1440 for V, 24 for l, and 10 for w.
$1440 = 240h$	Multiply.
$\dfrac{1440}{240} = \dfrac{240h}{240}$	Divide each side by 240.
$6 = h$	Simplify.

ANSWER The height of the prism is 6 millimeters.

What do you think?

Recreation

Your turn now Find the unknown length, width, or height of the rectangular prism.

4. $V = 24$ in.^{3}, $l = 6$ in., $w = 2$ in., $h = \underline{\ ?\ }$

5. $V = 360$ ft^3, $l = 10$ ft, $w = \underline{\ ?\ }$, $h = 9$ ft

6. $V = 125$ cm^3, $l = \underline{\ ?\ }$, $w = 2$ cm, $h = 12.5$ cm

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EXAMPLE 3 **Using the Volume of a Rectangular Prism**

Sand Sculpture A truck whose bed is 8 feet long, 5 feet wide, and 3 feet high is delivering sand for a sand sculpture competition. How many trips must the truck make to deliver 300 cubic feet of sand?

Solution

1 Find the volume of the bed of the truck.

$$V = lwh$$
$$= 8(5)(3) = 120 \text{ ft}^3$$

2 To find the number of truckloads of sand needed, divide 300 ft^3 by 120 ft^3.

$$300 \text{ ft}^3 \div 120 \text{ ft}^3 = 2.5$$

ANSWER Because it doesn't make sense to make 2.5 trips, the truck must make 3 trips to deliver 300 cubic feet of sand for the competition.

■ **Sand Sculpture**

The tallest hand-built sand sculpture was 24 feet tall and used 200 tons of sand. How many pounds of sand is that?

Getting Ready to Practice

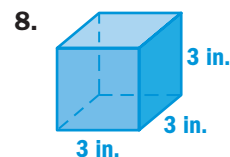1. **Vocabulary** Explain the difference between volume and surface area.

Find the volume of the rectangular prism.

2.
3 m, 5 m, 4 m

3.
4 in., 6 in., 15 in.

4.
5 cm, 8 cm, 5 cm
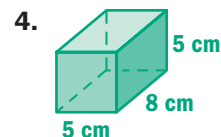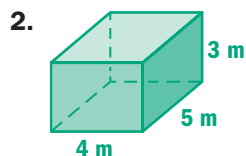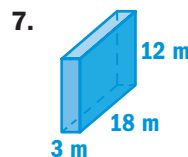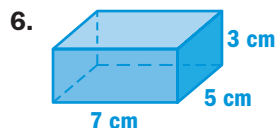
5. **Watermelons** In Japan, farmers have developed watermelons that are shaped like cubes and therefore fit better in refrigerators. What is the volume of a cubic watermelon whose edge length is 18 centimeters?

Practice and Problem Solving

Find the volume of the rectangular prism.

6.
3 cm, 5 cm, 7 cm

7.
12 m, 18 m, 3 m

8.
3 in., 3 in., 3 in.

9.
22 ft, 14 ft, 15 ft

10.
13 yd, 12 yd, 16 yd

11.
3.5 mm, 4 mm, 5.5 mm
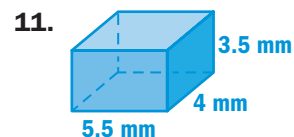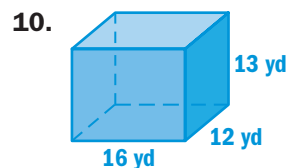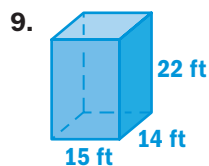
Algebra Find the unknown length, width, or height of the rectangular prism.

12. $V = 160 \text{ cm}^3$, $l = 10$ cm, $w = \underline{\ ?\ }$, $h = 8$ cm

13. $V = 400 \text{ ft}^3$, $l = 10$ ft, $w = 5$ ft, $h = \underline{\ ?\ }$

14. $V = 28 \text{ yd}^3$, $l = \underline{\ ?\ }$, $w = 1$ yd, $h = 7$ yd

15. **Estimation** Which of the following items would likely have a volume of 300 cubic inches? Explain your reasoning.

   A. Sugar cube   **B.** Cereal box   **C.** Refrigerator

16. **Aquarium** The dimensions of an aquarium are half as long as those of the aquarium on page 607. If the aquarium is filled with water, what is the mass of the water? Use the fact that for water 1 cm³ = 1 g.

Extended Problem Solving In Exercises 17–19, use the following information. A window box shaped like a rectangular prism has a length of 12 feet, a width of 9 inches, and a height of 9 inches.

17. Measurement Convert the dimensions of the window box to feet. Then find the volume of the window box.

18. Calculate One bag contains 2 cubic feet of soil. How many bags of soil must you buy to fill the window box? You must buy full bags of soil.

19. Estimation Each bag of soil costs $4.97, including tax. Estimate the cost of filling the window box with soil.

Favorite Books In Exercises 20 and 21, use the bar graph.

20. Writing Explain how the bar graph shown could be potentially misleading.

21. Critical Thinking How could the bar graph be redrawn using 3-D bars so it is not potentially misleading?

22. Challenge Find the volume and surface area of the solid.

Favorite Types of Books
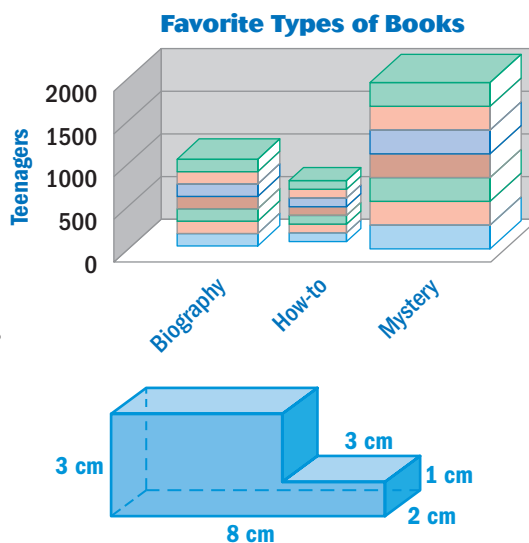
Mixed Review

Solve the equation. Check your solution. *(Lesson 7.4)*

23. $11a = 44$ **24.** $9b = 180$ **25.** $450 = 5c$ **26.** $36 = 4.5d$

27. Find the surface area of a cylinder that has a radius of 9 centimeters and a height of 5 centimeters. Use 3.14 for . *(Lesson 12.4)*

Basic Skills **Find the mean, median, mode(s), and range of the data.**

28. 45, 56, 35, 45, 57, 51, 52, 43   **29.** 2.2, 2.6, 3.3, 2, 7, 4.5, 3.3, 2, 1.1, 2

Test-Taking Practice

30. Extended Response Make an input-output table for a cube's edge length x and its volume y for edge lengths of 1 unit, 2 units, 3 units, and 4 units. Plot the ordered pairs in a coordinate plane. Then use the graph to decide whether the volume of a cube is a linear function of the cube's edge length. Explain your reasoning.