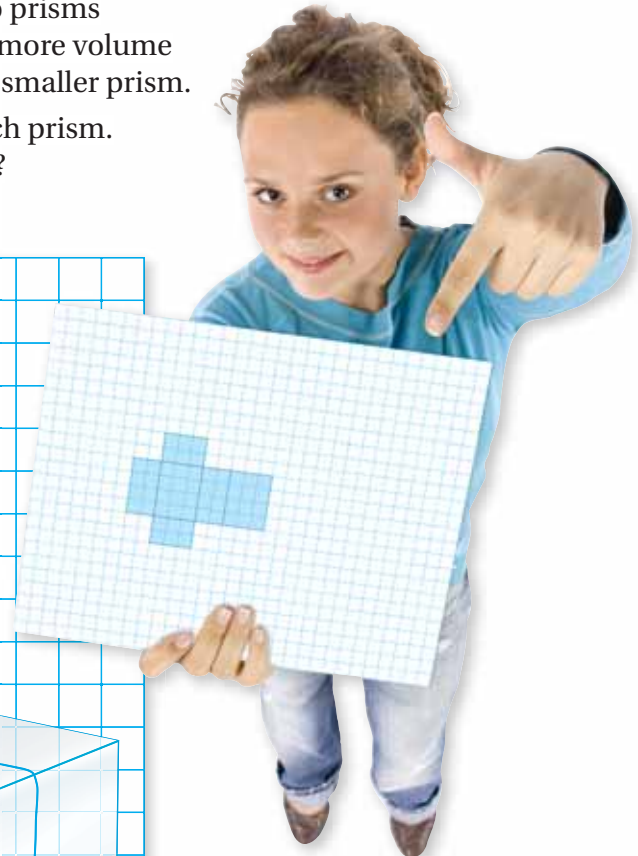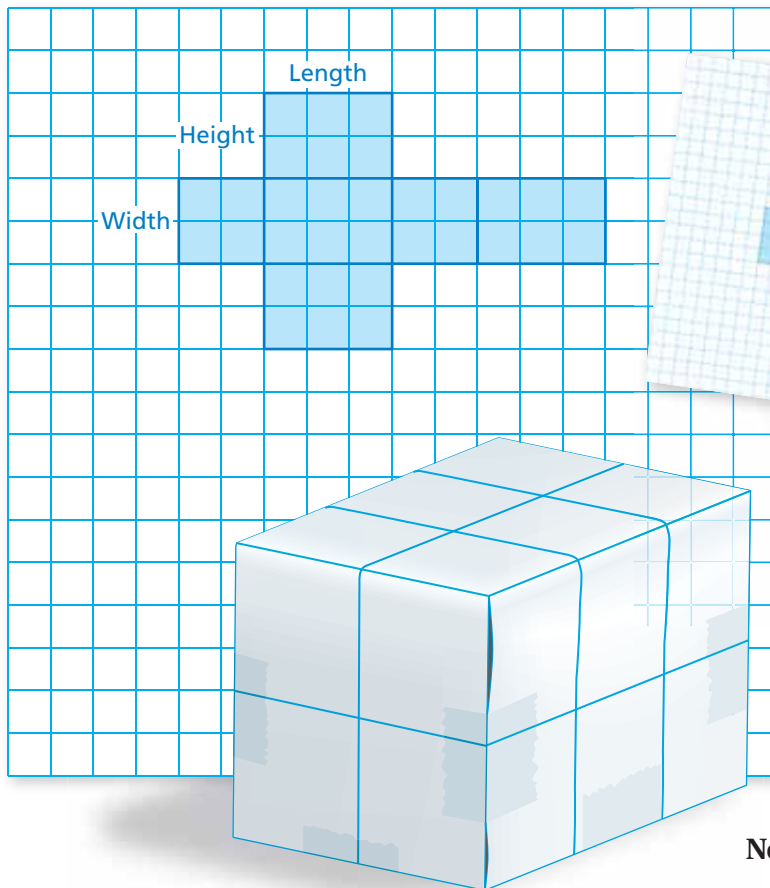**STANDARDS
OF LEARNING**
7.5

Essential Question How does changing a dimension of a rectangular prism affect its volume?

1 ACTIVITY: Comparing Volumes

Work with a partner.

a. Copy the net shown below on grid paper.

b. Double the width of the rectangular prism whose net is shown. Draw a net for the new prism.

c. Cut out both nets and fold them to form two prisms. Compare the two prisms visually. Estimate how much more volume the larger prism has than the smaller prism.

d. Find the actual volume of each prism. How close was your estimate?

Length

Height

Width

**Note:** You used these nets in Activities 1 and 2 in Section 8.1.

Work with a partner.

a. Double all three dimensions of the original prism in Activity 1: the width, length, and height.

b. Calculate the volume of the new prism. How many times greater is the volume of the new prism?

c. Triple all three dimensions of the original prism in Activity 1.

d. Calculate the volume of the new prism. How many times greater is the volume of the new prism?
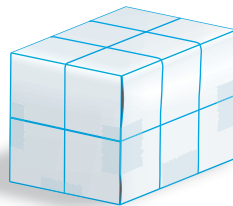
Original Prism
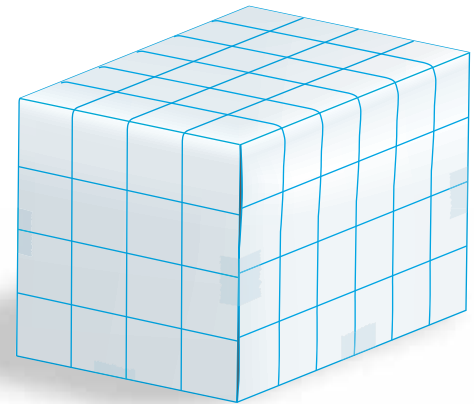
Prism with Dimensions Doubled

What Is Your Answer?

3. **IN YOUR OWN WORDS** How does changing a dimension of a rectangular prism affect its volume?

4. **BIG IDEAS SCIENCE** When designing an airplane, which of the following best describes your goal? Explain your reasoning.

a. Minimize surface area and maximize volume.

b. Minimize volume and maximize surface area.

Practice   Use what you learned about volumes of rectangular prisms to complete Exercises 3 and 4 on page 328.
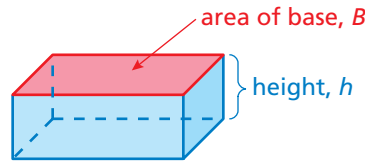
Key Vocabulary 🔊))
volume, *p. 326*

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

🔑 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.

area of base, B

height, h

Algebra $V = Bh$

Area of base ← → Height of prism

EXAMPLE 1 Finding the Volume of a Rectangular Prism
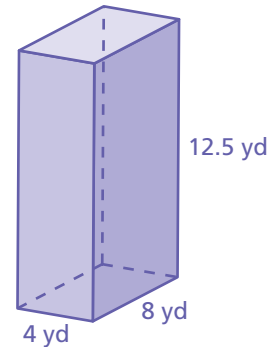
Study Tip

The area of the base of a rectangular prism is the product of the length ℓ and the width w.

You can use $V = \ell w h$ to find the volume of a rectangular prism.

Find the volume of the prism.

$V = Bh$ Write formula for volume.

$\quad = 8(4) \cdot 12.5$ Substitute.

$\quad = 32 \cdot 12.5$ Multiply.

$\quad = 400$ Multiply.

∴ The volume is 400 cubic yards.

12.5 yd

8 yd

4 yd

🔴 On Your Own

Now You're Ready
Exercises 5–10

Find the volume of the prism.

1.

7 ft

11 ft

9 ft

2.

16.4 m

5 m   3 m

🔊) **Multi-Language Glossary at** BigIdeasMath ✓com.
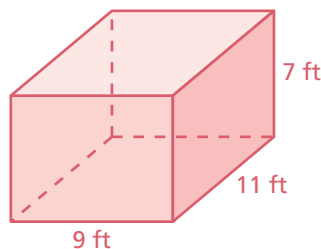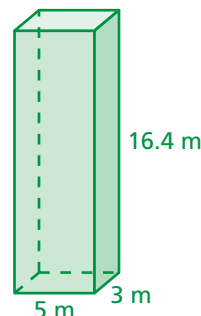
EXAMPLE **2**   **Changing One Dimension of a Rectangular Prism**

Does doubling the height of the prism (a) double its volume? (b) double its surface area? Explain.

Prism A

Prism A

2 ft

5 ft

7 ft

Prism A   *Prism B*

a. $V = Bh$ $V = Bh$
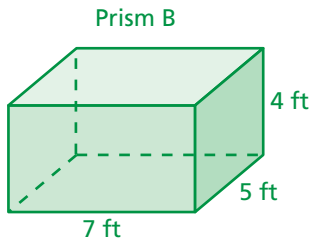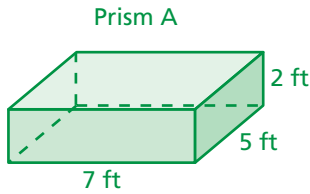
   $= 7(5) \cdot 2 = 70 \text{ ft}^3$ $= 7(5) \cdot 4 = 140 \text{ ft}^3$

:•: The ratio of the volumes is $\dfrac{140 \text{ ft}^3}{70 \text{ ft}^3} = 2$. So, doubling the height

of the prism doubles the volume.

Prism B

4 ft

5 ft

7 ft

b. $S = 2\ell w + 2\ell h + 2wh$ $S = 2\ell w + 2\ell h + 2wh$

   $= 2(7)(5) + 2(7)(2) + 2(5)(2)$ $= 2(7)(5) + 2(7)(4) + 2(5)(4)$

 $= 70 + 28 + 20 = 118 \text{ ft}^2$ $= 70 + 56 + 40 = 166 \text{ ft}^2$

:•: The ratio of the surface areas is $\dfrac{166 \text{ ft}^2}{118 \text{ ft}^2} \approx 1.4$. So, doubling

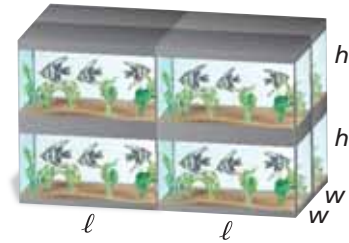the height of the prism does *not* double the surface area.

EXAMPLE **3**   **Real-Life Application**

You can keep three angelfish in your aquarium. You buy an aquarium whose dimensions are two times greater. How many angelfish can you keep in your new aquarium?

Original aquarium

h

h

h

ℓ w

ℓ ℓ w

w
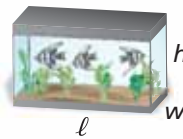
3 fish
$V = \ell w h$

n fish
$V = 8 \cdot \ell w h$

:•: The ratio of the volumes is $\dfrac{8 \cdot \ell w h}{\ell w h} = 8$. So, you can keep a maximum

of $8 \cdot 3 = 24$ angelfish in your new aquarium.

🔴 **On Your Own**

Now You're Ready
Exercises 14–16

3. **WHAT IF?** In Example 2, does tripling the height (a) triple the volume? (b) triple the surface area? Explain.

4. **WHAT IF?** In Example 3, you buy an aquarium whose dimensions are three times greater. How many angelfish can you can keep in your new aquarium?

Check It Out
Help with Homework
BigIdeasMath.com

✓ Vocabulary and Concept Check

1. **VOCABULARY** What types of units are used to describe volume?

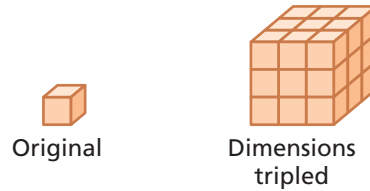2. **CRITICAL THINKING** How are volume and surface area different?

Practice and Problem Solving

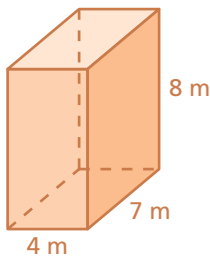**Find the volume of each prism. How many times greater is the volume of the larger prism?**
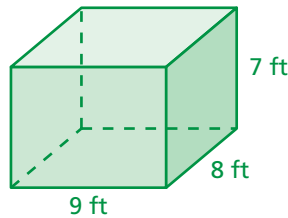
3.

Original

Dimensions
doubled

4.

Original

Dimensions
tripled

Find the volume of the prism.

5.

8 m
7 m
4 m

6.

7 ft
8 ft
9 ft

7.

7 cm
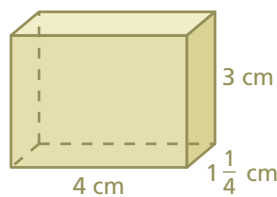7 cm
7 cm

8.

2 in.
4 in.
8.5 in.

9.

3 cm
4 cm
$1\frac{1}{4}$ cm

10.

5 mm
10 mm
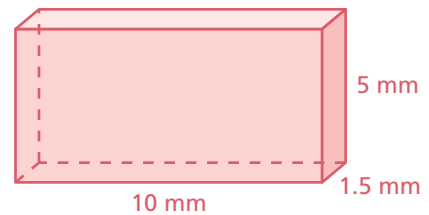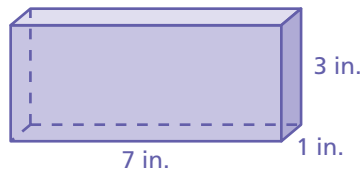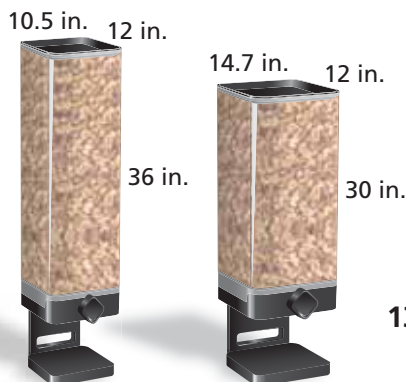1.5 mm

11. **ERROR ANALYSIS** Describe and correct the error
in finding the volume of the prism.

3 in.
7 in.
1 in.

✗
$V = Bh$
$= 7(1) \cdot 3$
$= 21$ in.^{2}

10.5 in. 12 in.

14.7 in. 12 in.

36 in.

30 in.

12. **MAIL** A box delivered in the mail is 7.5 inches by
2.6 inches by 9 inches. What is the volume of the box?

13. **BULK FOODS** Each bulk food dispenser is shaped like a
rectangular prism. Which holds more food? Explain.

In Exercises 14 and 15, use the prism shown.

**② 14.** Double the width of the prism. How many times greater is the volume of the new prism than the volume of the original prism?

15. Triple the length of the prism. How many times greater is the volume of the new prism than the volume of the original prism?

3 in.
2 in.
5 in.

16. REASONING Are your results in Exercises 14 and 15 true for any prism? Are these results true for surface area? Explain.

17. SANDBOX A sandbox at a playground is being rebuilt.

    a. Find the volume of the sandbox.

    b. After changing only one dimension, the volume of the new sandbox is 15 cubic feet. Describe how this could happen.

0.25 ft
4 ft
7.5 ft
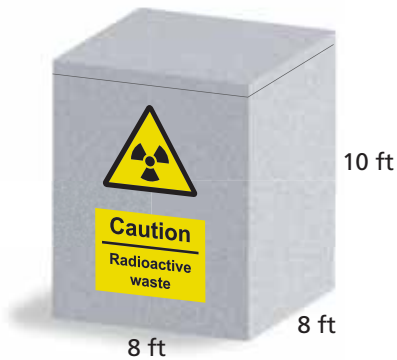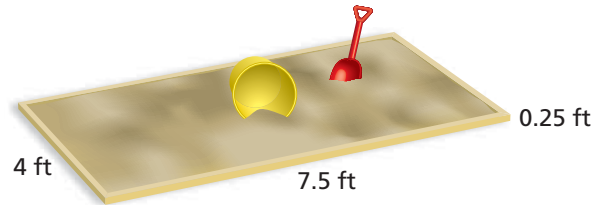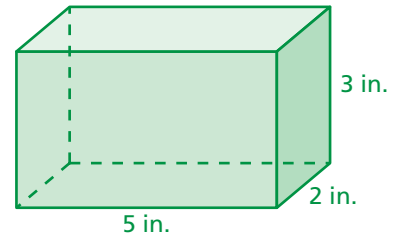
18. WASTE A radioactive waste storage container is shown.

    a. Find the volume of the container.

    b. The dimensions of a larger container are three times greater. Find the volume of the larger container.

    c. It costs \$256,000 to dispose of the waste in the smaller container. How much does it cost to dispose of the waste in the larger container?

10 ft

Caution
Radioactive
waste

8 ft
8 ft

19. **Critical Thinking** How does the given change affect the volume and surface area of a rectangular prism?

    a. Height doubles

    b. Height triples

    c. All three dimensions double

    d. All three dimensions triple

h
w
ℓ
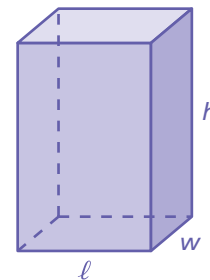
Fair Game Review What you learned in previous grades & lessons

Identify the transformation. *(Section 7.1, Section 7.2, and Section 7.3)*

20.

21.

22.
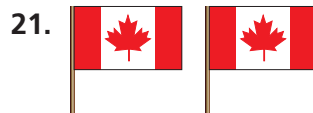
23. MULTIPLE CHOICE What is the solution of $\dfrac{x}{4} = \dfrac{22}{5}$? *(Section 5.5)*

    Ⓐ 1   **Ⓑ** 17.6   **Ⓒ** 21   **Ⓓ** 25.4