9-5 Exploring Similar Solids

Check Skills You'll Need

1. **Vocabulary Review** What is a *proportion*?

Solve each proportion.

2. $\frac{x}{4} = \frac{7}{16}$
3. $\frac{9}{5} = \frac{m}{24}$
4. $\frac{3}{k} = \frac{9}{27}$

GO for Help Lesson 3-3

CONTENT STANDARD
8.G.9

What You'll Learn

To use proportions to find missing measurements of similar solids, including surface area and volume

New Vocabulary similar solids

Why Learn This?

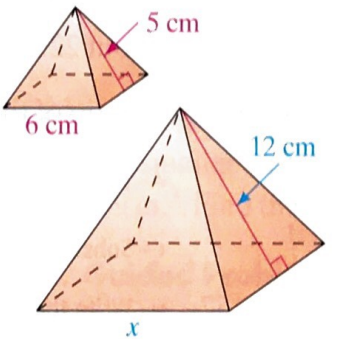
The dolls in the photo at the right have proportional heights and diameters. These and other art objects are examples of similar solids.

Two solids are **similar solids** if they have the same shape and if all of their corresponding dimensions are proportional.

You can use a proportion to find the unknown dimensions of similar solids.

EXAMPLE Finding Dimensions of a Similar Solid

1 The two pyramids below are similar. Find the value of x.



Use corresponding parts to write a proportion.

$\frac{x}{6} = \frac{12}{5}$ ← dimensions of large pyramid / ← dimensions of small pyramid

$6 \cdot \frac{x}{6} = \frac{12}{5} \cdot 6$ ← Multiply each side by 6.

$x = \frac{72}{5}$ ← Simplify.

$= 14.4$

The base-edge length x is 14.4 cm.

GO for Help
For help with proportions and similar figures, go to Lesson 7-4, Example 2.

Quick Check

1. Two cylinders are similar. The small cylinder has a diameter of 4 m and a height of h. The large cylinder has a diameter of 5 m and a height of 11 m. What is the value of h?

KEY CONCEPTS Surface Area and Volume of Similar Solids

If the ratio of the corresponding dimensions of similar solids is $\frac{a}{b}$, then

- the ratio of surface areas is $\frac{a^2}{b^2}$ and
- the ratio of volumes is $\frac{a^3}{b^3}$.

You can use ratios of corresponding dimensions to find the surface area and volume of similar solids.

EXAMPLE 2 Surface Area and Volume of Similar Solids

Pottery The surface area of the cylindrical pitcher below is about 90 in.^{2}. Its volume is about 157 in.^{3}. The pitcher and creamer are similar. Find the surface area and volume of the creamer.

Pitcher Creamer

The ratio of the diameters is $\frac{3}{6}$, or $\frac{1}{2}$. So the ratio of the surface areas is $\frac{1^2}{2^2}$, or $\frac{1}{4}$.

$$\frac{\text{surface area of creamer}}{\text{surface area of pitcher}} = \frac{1}{4} \quad \leftarrow \text{Write a proportion.}$$

$$\frac{S}{90} = \frac{1}{4} \quad \leftarrow \text{Substitute the surface area of the pitcher.}$$

$$4 \cdot S = 1 \cdot 90 \quad \leftarrow \text{Write the cross products.}$$

$$S = 22.5 \quad \leftarrow \text{Simplify.}$$

The surface area of the creamer is about 22.5 in.^{2}.

If the ratio of the diameters is $\frac{1}{2}$, the ratio of the volumes is $\frac{1^3}{2^3}$, or $\frac{1}{8}$.

$$\frac{\text{volume of creamer}}{\text{volume of pitcher}} = \frac{1}{8} \quad \leftarrow \text{Write a proportion.}$$

$$\frac{V}{157} = \frac{1}{8} \quad \leftarrow \text{Substitute the volume of the pitcher.}$$

$$8 \cdot V = 1 \cdot 157 \quad \leftarrow \text{Write the cross products.}$$

$$V = 19.625 \quad \leftarrow \text{Simplify.}$$

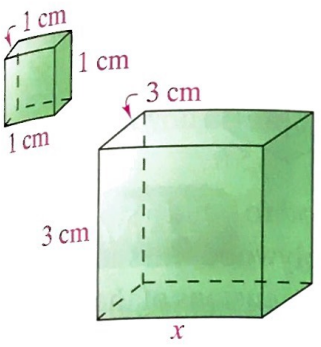
The volume of the creamer is about 20 in.^{3}.

Careers Some potters make ceramic pieces by shaping wet clay as it spins on a potter's wheel.

Quick Check

2. A box has a surface area of about 54 in.^{2} and a volume of about 27 in.^{3}. The edge lengths of the box are about $\frac{1}{3}$ of the edge lengths of a larger box. Find the surface area and volume of the larger box.

Check Your Understanding



1. **Vocabulary** What does it mean to say that two rectangular solids are similar?

Use the similar figures at the right for Exercises 2–4.

2. What proportion would you write to find x?
3. The surface area of the smaller cube is 6 cm^2. What is the surface area of the larger cube?
4. **Mental Math** The volume of the smaller cube is 1 cm^3. What is the volume of the larger cube?

Homework Exercises

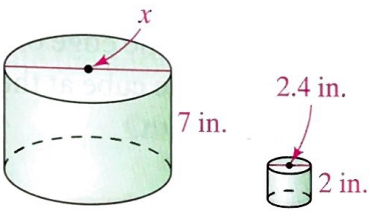
For more exercises, see Extra Skills and Word Problems.

GO for Help

For Exercises	See Examples
5–6	1
7–9	2

For each pair of similar solids, find the value of the variable.

5.



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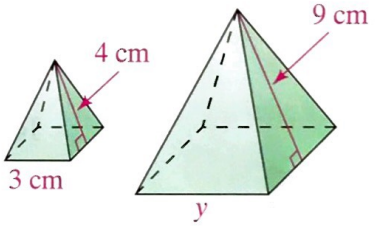
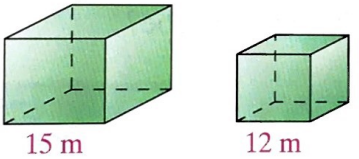


Find the surface area and volume of each smaller similar solid.

7. S.A. = 1,575 m^2
V = 4,050 m^3



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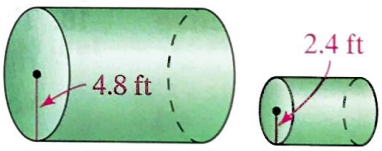

S.A. = 356 ft^2
V = 507 ft^3

9. **Vases** Two similar cylindrical vases have diameters of 6 in. and 8 in. The smaller vase has a surface area of 1,960 $in.^2$ and a volume of 339 $in.^3$. Find the surface area and volume of the larger vase.

GPS

10. **Guided Problem Solving** A glass cube has edges that are $\frac{3}{4}$ of the length of the edges of a larger cube. The larger cube has a surface area of 6,000 cm^2. What is the surface area of the smaller cube?
    - The ratio of the surface areas is ■.
    - How can you use the ratio of the surface areas in a proportion to find the surface area of the smaller cube?
11. Two prisms are similar. The larger prism has a height of 18 m and a base-edge length of 20 m. The smaller prism has a height of 4.5 m. What is the base-edge length of the smaller prism?

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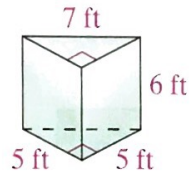
12. **Number Sense** Amelia sees two cubic sculptures. She estimates the edge length of the larger sculpture is between 2.5 and 3 times the edge length of the smaller one. How much greater should she estimate the volume of the larger sculpture to be? Explain.

13. A second figure with a height of 19 ft is similar to the figure at the right. Find the surface area and volume of the second figure.

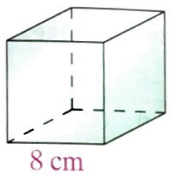


14. **Carpentry** Gina used 78 square feet of plywood to build a storage bin to hold her gardening supplies. How much plywood will she need to build a similar box for her hand tools if the dimensions of the box are half the dimensions of the bin?

15. **Writing in Math** Explain how to determine whether two cones are similar.

16. **Algebra** Two prisms are similar. The surface area of one is four times the surface area of the other. What is the ratio of the corresponding dimensions?

17. **Challenge** How long is the edge of a cube whose volume is twice that of the cube at the right? Round to the nearest tenth.



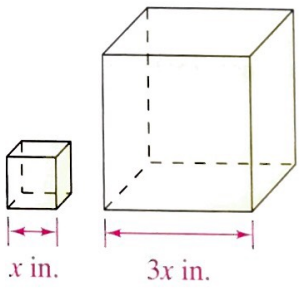
Test Prep and Mixed Review

Practice

Gridded Response

18. The volume of the larger cube at the right is 216 cubic inches. What is the volume of the smaller cube?

Ⓐ $6\ \text{in.}^3$
Ⓑ $8\ \text{in.}^3$
Ⓒ $24\ \text{in.}^3$
Ⓓ $72\ \text{in.}^3$



19. A scouting troop raised $285 for charity by washing cars on two consecutive Saturdays. They washed 26 cars for $5 per car the first Saturday. How many cars did they wash at this price the next Saturday?

Ⓕ 23 Ⓖ 25 Ⓗ 27 Ⓙ 31

20. There are 5.256×10^5 minutes in a year. A teenager's heart beats about 80 times per minute. How many times does it beat in a year?

Ⓐ 6.57×10^7
Ⓑ 6.57×10^3
Ⓒ 4.205×10^7
Ⓓ 4.205×10^3

Write each number in scientific notation.

21. 75,000
22. 0.00194
23. 0.000083

GO for Help

For Exercises	See Lesson
21–23	6-1