Applications Connections Extensions ACE

Applications

1. a. Make a sketch of an open 1-3-5 box. Label the edges of the box.

b. Sketch three boxes that have twice the volume of a 1-3-5 box. Label each box with its dimensions.

c. Are any of the three boxes in part (b) similar to the 1-3-5 box? Explain.

For Exercises 2–4, find the volume and the surface area of each closed box.

2. 1-2-2 **3.** 1.5-1.5-3 **4.** 2-4-1

For Exercises 5–7, decide if each pair of cylinders are similar. For each pair of similar cylinders, describe how many times larger one is than the other.

5. Cylinder 1: height = 10 centimeters, radius = 5 centimeters
Cylinder 2: height = 5 centimeters, radius = 2.5 centimeters

6. Cylinder 1: height = 10 centimeters, radius = 5 centimeters
Cylinder 2: height = 30 centimeters, radius = 15 centimeters

7. Cylinder 1: height = 10 centimeters, radius = 5 centimeters
Cylinder 2: height = 15 centimeters, radius = 10 centimeters

8. a. Make a sketch of an open 2-2-3 box and an open 2-2-6 box. Label the edges of the boxes.

b. Find the volume of each box in part (a).

c. Find the surface area of each box in part (a).

d. Suppose you want to adapt the 1-2-3 compost box recipe for the boxes in part (a). How many worms and how much paper and water would you need for each box?

9. a. Give the dimensions of a rectangular box that will decompose 5 pounds of garbage per day. Explain your reasoning.

b. Is your box similar to the 1-2-3 box? Explain.

10. One cube has edges measuring 1 foot. A second cube has edges measuring 2 feet. A third cube has edges measuring 3 feet.

a. Make scale drawings of the three cubes. For each cube, tell what length in the drawing represents 1 foot.

b. Find the surface area of each cube.

c. Describe what happens to the surface area of a cube when the edge lengths are doubled, tripled, quadrupled, and so on.

11. a. Find the volume of each cube in Exercise 10.

b. Describe what happens to the volume of a cube when the edge lengths are doubled, tripled, quadrupled, and so on.

For Exercises 12–14, decide if each pair of rectangular boxes is similar. For each pair of similar boxes, describe how many times larger one box is than the other box.

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12. 1-2-5 and 3-6-15

13. 2-3-2 and 5-6-5

14. 2-1-4 and 3-1.5-6

15. In the United States, an average of 2.7 pounds of garbage per person is delivered to landfills each day. A cubic foot of compressed garbage weighs about 50 pounds.

a. Estimate the amount of garbage produced by a family of four in one year.

b. Estimate the amount of garbage produced by the families of a class of 20 students in one year. Assume each family has four people.

16. Each year the United States generates 450 million cubic yards of solid waste. Mr. Costello's classroom is 42 feet long, 30 feet wide, and 12 feet high. How many rooms of this size would be needed to hold all this garbage?

17. For every ton of paper that is recycled, about 17 trees and 3.3 cubic yards of landfill space are saved. In the United States, the equivalent of 500,000 trees are used each week to produce the Sunday papers. Suppose all the Sunday papers this week are made from recycled paper. How much landfill is saved?

In Exercises 18 and 19, a company that specializes in creating models of buildings is hired to develop models of pools for the upcoming summer Olympics. The pools are rectangular prisms. The scale factor from the model to the actual pool is 120.

18. a. The dimensions of the actual diving pool are 20 meters by 20 meters by 4.9 meters. What are the dimensions of the model diving pool?

b. What is the capacity (volume) of the actual diving pool. What is the capacity of the model diving pool?

c. What is the surface area of the actual diving pool? What is the surface area of the model diving pool? (Do not include the surface of the water.)

19. a. The planned water capacity of the pool used for water polo and swimming is 1,650 cubic meters. What is the capacity of the model pool?

b. A sunken corridor with viewing windows is planned for the diving pool. The area of a window in the actual setting is 160 square feet. What is the area of the window on the model?

Connections

20. For parts (a)–(e), find the measure that makes a true statement.

a. 1 square foot = ■ square inches

b. 1 square yard = ■ square inches

c. 1 cubic yard = ■ cubic feet

d. 2 square yards = ■ square inches

e. 3 square yards = ■ square inches

f. For parts (a), (b), and (e) above, draw a diagram to justify your answer.

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For Exercises 21–23, find the measure that makes a true statement.

21. 4 square meters = ■ square centimeters

22. 1 cubic meter = ■ cubic centimeters

23. 6 cubic centimeters = ■ cubic millimeters

24. For the compost boxes in Problem 5.2, find the ratios in parts (a)–(c).

a. the length of each side of the 1-2-3 box to the length of the corresponding side of the 2-4-6 box

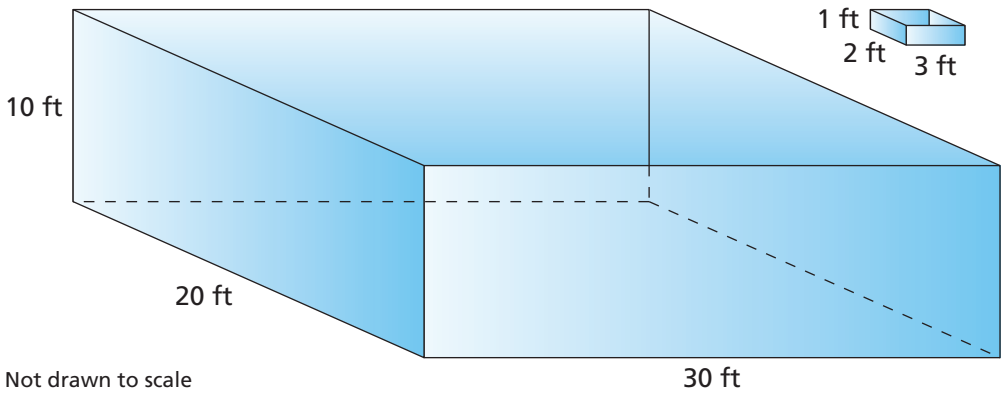
b. the surface area of the 1-2-3 box to the surface area of the 2-4-6 box

c. the volume of the 1-2-3 box to the volume of the 2-4-6 box

d. How is each ratio in parts (a)–(c) related to the scale factor from the 1-2-3 box to the 2-4-6 box?

25. At the movie theater, a large cylindrical container of popcorn costs $5.00, and a small cylindrical container costs $2.50. Denzel thinks that the heights of the containers are about the same and that the radius of the large container is about twice the radius of the small container. To get the most popcorn for his $5.00, should Denzel buy one large popcorn or two small popcorns? Explain.

26. A compost company builds and sells 1-2-3 compost boxes. They need to store a supply of the boxes in their warehouse to fill customers' orders. The sketches below show a 1-2-3 box on the right and the space in the warehouse allotted for the boxes on the left.



a. How many 1-2-3 boxes can be stored in one layer on the floor of the storage space?

b. How many layers of boxes can be stacked in the storage space?

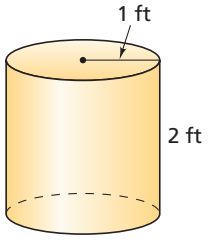
c. How many boxes can be stored in the storage space?

27. Mary's class decides to build a cylindrical compost box. Mary calculates that a cylindrical container with a height of 2 feet and a radius of 1 foot would decompose 0.5 pound of garbage each day. She calls this container a 1-2 cylinder.

a. How does the volume of the 1-2 cylinder compare with the volume of the 1-2-3 box?

b. How does the surface area of the 1-2 cylinder compare with the surface area of the 1-2-3 box?

c. Mary's class estimates that they throw away about 1 pound of garbage at school each day. What size cylinder should they build to handle this much garbage?



28. The two legs of a right triangle are in the ratio 3 : 4.

a. Sketch and label the described triangle. Then sketch and label two other similar right triangles.

b. Suppose you create a similar right triangle by doubling the length of the legs. How will the area of the first triangle be related to the area of the second triangle?

29. A football field is 120 yards long, including the end zones, and $53\frac{1}{3}$ yards wide.

a. How many square yards are in the football field?

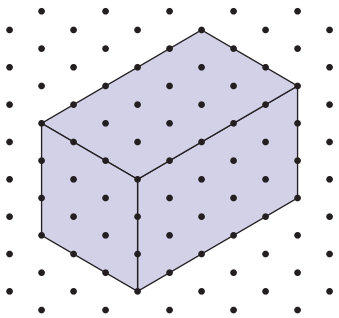
b. How many square feet are in the football field?

c. What is the relationship between the number of square yards and square feet in the football field?

d. Describe what happens to the number of square feet in the area of a rectangle when the unit of measure for length and width is $\frac{1}{3}$ the size of the original unit.

For Exercises 30–32, find the volume and surface area of each box shown.

30.



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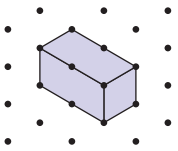
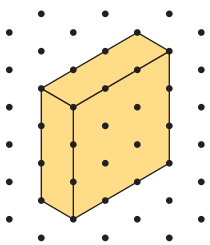
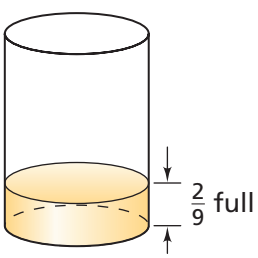


32.



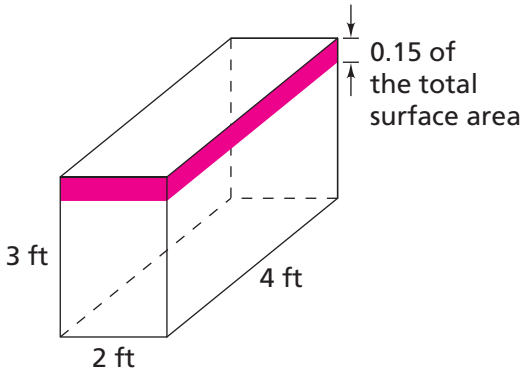
33. After a container of water is poured into a cylindrical tank, the tank is $\frac{2}{9}$ full. How many containers of water are needed to fill the tank to $\frac{3}{4}$ full?



34. Anna uses exactly one small can of red paint to cover a strip around the top of an open chest. The red strip around the top is 0.15 of the total surface area (without the top and bottom of the chest).

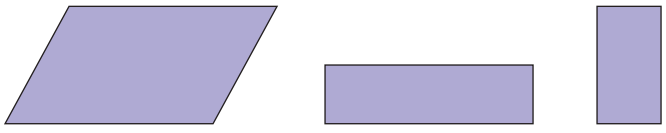
a. How many small cans of blue paint does she need to paint the rest?

b. What is the surface area of the chest, not including the top and bottom?



Extensions

35. The following sketches show the front, top, and right side views of a "tilted box" in which two of the six faces are non-rectangular parallelograms. The top and the bottom faces are identical rectangles, and the right and left faces are identical rectangles. (This is called an *oblique prism*.)



a. Make a sketch of the box.

b. What measurements do you need to find the volume of the box? How can you use these measurements to find the volume?

c. What measurements do you need to find the surface area of the box? How can you use these measurements to find the surface area?

36. Is the price of a box of cereal directly related to its volume? Collect some data to help you answer this question.

a. Record the dimensions and prices of two or three different-sized boxes of the same cereal brand.

b. Calculate the volume of each box.

c. Calculate the cost per unit of volume for each box. Compare the results for the different boxes.

d. Write a short report summarizing what you learned about the relationship between box size and cereal price.

37. A cake, a loaf of bread, or a brick of cheese could be called a "sliceable" rectangular prism.

a. How many different ways can you slice such a prism into two pieces of equal volume?

b. If the prism were a cube, how many ways could you slice it into two pieces of equal volume?

For each pair of cylinders in Exercises 38–40, find the ratio of each measurement of Cylinder A to the corresponding measurement of Cylinder B.

a. the radius

b. the height

c. the surface area

d. the volume

38. The dimensions of Cylinder A are twice the dimensions of Cylinder B.

39. The dimensions of Cylinder A are three times the dimensions of Cylinder B.

40. The dimensions of Cylinder A are four times the dimensions of Cylinder B.