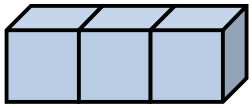
Changing Dimensions: Volume

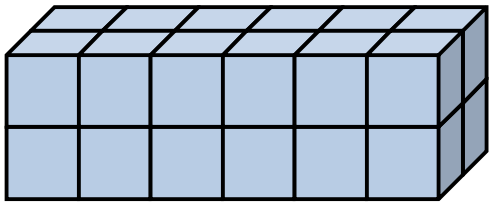
Extend Your Learning
Answers and Explanations

1. Determine the surface area and volume of the following rectangular prisms.
   The surface area of a prism is equal to the sum of the areas of the faces. The top, bottom, front, and back faces of each of the following prisms have the same area, so we can determine the area of one face and multiply by 4. The left and right face of each prism have the same area, so we can determine the area of one face and multiply by 2.



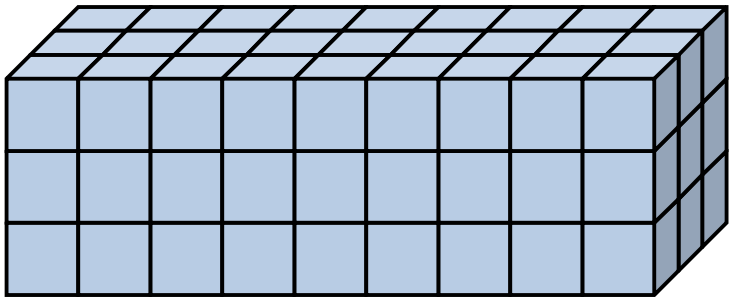
S.A. = (4 • 3) + (2 • 1)
= 12 + 2
= 14 square units

V = 3 • 1 • 1
= 3 cubic units



S.A. = (4 • 12) + (2 • 4)
= 48 + 8
= 56 square units

V = 6 • 2 • 2
= 24 cubic units



S.A. = (4 • 27) + (2 • 9)
= 108 + 18
= 126 square units

V = 9 • 3 • 3
= 81 cubic units

2. Study your results for problem 1. What happens to the surface area and volume of a rectangular prism when you double the dimensions? Triple the dimensions?
   When you double the dimensions, the surface area becomes 4 times as large (4 x 14 = 56), and the volume becomes 8 times as large (8 x 3 = 24).
   When you triple the dimensions, the surface area becomes 9 times as large (9 x 14 = 126) and the volume becomes 27 times as large (27 x 3 = 81).

3. How will the surface area and volume of a rectangular prism change when you make each dimension n times as large?
   When you make the dimensions n times as large, the surface area becomes n^2 times as large and the volume becomes n^3 times as large.

4. Sam's grandma has two loaf pans. The larger loaf pan measures 9 in. by 5 in. by 3 in. and holds 8 cups of batter. The mini-loaf pan only holds 1 cup of batter. If the pans are similar in shape, what are the dimensions of the mini-loaf pan?
   The mini-loaf pan holds 1/8 as much batter as the larger loaf pan, so the volume factor is 1/8. That means the scale factor is 1/2, so each dimension of the mini-loaf pan is 1/2 as large as the larger pan. The mini-loaf pan measures 4.5 in. by 2.5 in. by 1.5 in.

   9 in. ÷ 2 = 4.5 in. 5 in. ÷ 2 = 2.5 in. 3 in. ÷ 2 = 1.5 in.

5. After a large storm, a neighbor cuts a fallen tree trunk into two pieces. The first piece was approximately 5 ft. long while the second piece was approximately 12½ ft. long. What is the relationship between the volume of wood in the smaller piece compared to the larger piece assuming the trunk has a consistent radius?
   Since the second piece is approximately 2½ times as long as the first piece (12½ ÷ 5 = 2½), the volume will be 2½ times as large as the first piece.

6. Lovely Locks shampoo bottle is cylindrical. It is 10 in. tall and has a diameter of 4.5 in. The travel size container is 5 in. tall and has a diameter of 2.25 in. The prices of the bottles are $6.25 and $1.50, respectively. Are these fair prices in comparison to the sizes of the bottles? Why or why not?
   Since each dimension of the large bottle is twice as large as the dimension of the small bottle, the volume of the large bottle is 8 times the volume of the small bottle. That means the price of the large bottle should be about 8 times the price of the small bottle, or the price of the small bottle should be about 1/8 the price of the large bottle. The large bottle costs approximately 4 times as much of as the small bottle (6.25 ÷ 1.5 ≈ 4), so the prices are not fair in comparison to the sizes of the bottles. The large bottle is a better value.

7. A physical education teacher is rearranging equipment. Currently, one container holds 30 baseballs. She is considering putting the hockey pucks in the container instead. If baseballs are approximately 3 inches in diameter and hockey pucks are 3 inches diameter and 1 inch thick, how many pucks will the container hold?
   Three hockey pucks will fit in the place of one baseball, so the container should hold 3 times as many hockey pucks as baseballs. This means the container should hold 90 hockey pucks.