

Volume and Surface Area of Rectangular Prisms

All Boxed Up

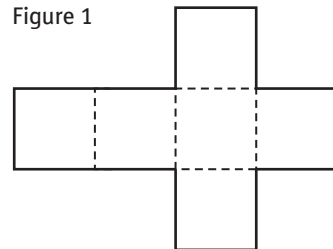
SUGGESTED LEARNING STRATEGIES: Activating Prior Knowledge, Use Manipulatives, Visualization, Group Presentation, Think/Pair/Share

My Notes

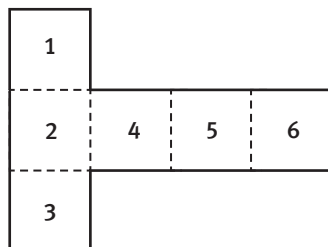
ACADEMIC VOCABULARY

net

The shape in Figure 1 is a **net**. A net is a two-dimensional drawing used to represent or form a three-dimensional object or solid.



1. Cut out Figure 1 on page 249 and fold it along the dotted lines to form a box. The figure formed is a cube. Describe the characteristics that make it a cube.
2. The net below will also form a cube. If face number 1 is the bottom of the cube, which numbered face is the top of the cube?



3. Many other nets can be used to represent a cube.
 - a. Use graph paper to draw as many of these other nets as you can find. Cut out each net and fold it to verify that a cube can be formed.
 - b. Sketch the nets you found that form a cube in the My Notes space.
 - c. Sketch below two nets made up of six squares that do not form a cube.

My Notes

ACADEMIC VOCABULARY

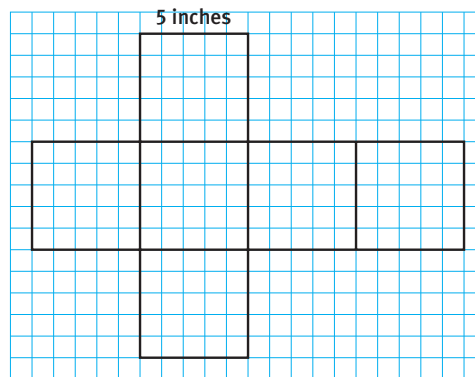
The **area** of a plane figure is the measure in square units of its interior region.

SUGGESTED LEARNING STRATEGIES: : Interactive Word Wall, Summarize/Paraphrase/Retell, Discussion Group, Look for a Pattern

In Elaine’s new business, All Boxed Up, she sells shipping materials, including boxes and packing peanuts. Her box supplier charges her $\frac{1}{2}$ cent per square inch of surface area for each box. Elaine can determine the **surface area** of a box by adding the areas of the six faces of the box (front, back, top, bottom, left, and right).

Elaine must now find the surface areas of many boxes of different sizes, so she wants to find a pattern that will help shorten this work. Help her find the pattern.

4. One type of box that Elaine will keep in stock at All Boxed Up is a cube. For one of the cube-shaped boxes, the length of each edge is 5 inches.



- a. Find the area of each face.
- b. Find the total surface area of the cube.

5. Elaine wants to make a data table for the cube-shaped boxes.

- a. Record your answer from Item 4. Then complete the table for other cube-shaped boxes that will be in stock.

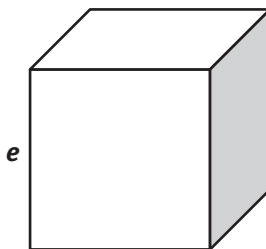
Length of Edge (in.)	Number of Faces	Area of One Face (in. ²)	Surface Area (in. ²)
5			
6			
7			
8			
		100	
			1350

- b. Describe any patterns you see in the table above.
- c. For each box, how does the area of one face relate to the surface area?

SUGGESTED LEARNING STRATEGIES: Create Representations, Group Presentation, Identify a Subtask, Interactive Word Wall, Use Manipulatives

6. You can use a variable to represent the length of the edge of a cube.

- a. In the figure to the right, what variable is used to represent the length of the edge of the cube?



- b. Write a rule, in terms of the variable, for finding the surface area of a cube.

7. Cube-shaped boxes with 12-inch edges are kept in stock at All Boxed Up.

- a. Determine the surface area of a box with 12-inch edges.
- b. The supplier charges Elaine $\frac{1}{2}$ cent per square inch of surface area for each box. Determine how much profit Elaine will make on a 12-inch cube-shaped box if she sells it for \$4.95. Show your work.

8. Another type of box is a **rectangular prism**. In a rectangular prism, all the faces are rectangles but not necessarily squares. Look at Figure 2, which is a rectangular prism, on page 249. Show the calculations to find the area of each face. Then find the surface area of the prism.

Face	Calculation	Area (in. ²)
1		
2		
3		
4		
5		
6		

Surface area of Figure 2 = _____

My Notes

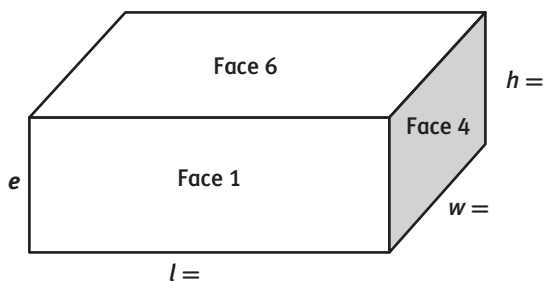
MATH TERMS

A **prism** is a solid with parallel congruent bases which are both polygons. The faces (sides) of a prism are all parallelograms or rectangles. A prism is named according to the shape of its bases.

My Notes

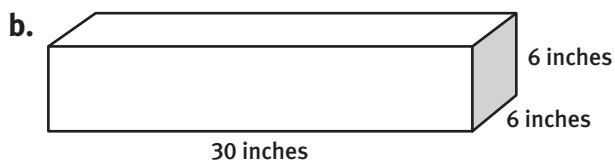
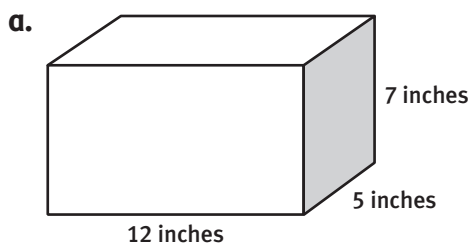
SUGGESTED LEARNING STRATEGIES: Use Manipulatives, Think/Pair/Share

9. Cut out Figure 2 on page 249. Fold it to form a rectangular prism. Make folds so that the measurements are on the outside.
- a. Label the length, width, and height of the rectangular prism you formed on this diagram.



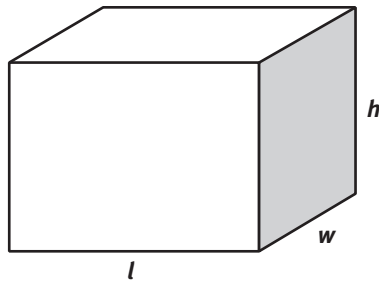
- b. Faces 2, 3, and 5 cannot be seen in the diagram above. Describe the location of each of these hidden faces.
- Face 2:
- Face 3:
- Face 5:
- c. Which pairs of faces have the same area?

10. Calculate the surface area of each rectangular prism. Show your work.



SUGGESTED LEARNING STRATEGIES: Create Representations, Identify a Subtask, RAFT

- 11.** Write a rule that Elaine can use to determine the surface area of a rectangular prism with the length, width, and height represented by the variables l , w , and h . Explain how you found the rule.



- 12.** Elaine is stocking a new box that is 24 inches long, 12 inches wide, and 10 inches high. Make a recommendation to Elaine regarding a price for this size box. Remember that her box supplier charges her $\frac{1}{2}$ cent per square inch of surface area for each box. Be certain to explain how you arrived at your recommendation.

Elaine plans to sell packing peanuts at All Boxed Up. She knows that surface area will not tell her how many packing peanuts she needs to fill a box. She knows the **volume** of a box will help in estimating the number of packing peanuts needed to fill the box. Volume is measured in cubic units.

Cubes are named for the lengths of their edges. A 1-inch cube is a cube with edges that are 1 inch in length. A 2-inch cube is a cube with edges that are 2 inches in length. Any size cubes can be used to build larger cubes.

My Notes

ACADEMIC VOCABULARY

Volume is the measure of the space occupied by a solid. It is measured in cubic units such as cubic inches (in.^3).

My Notes

SUGGESTED LEARNING STRATEGIES: Use Manipulatives, Look for a Pattern, Create Representations

- 13.** Elaine uses unit cubes, similar to the ones your teacher has given you, as models of 1-inch cubes.
- a.** Use your unit cubes to build models of 2-inch cubes and 3-inch cubes. Then complete this table.

Length of Edge (in.)	Area of Face (in. ²)	Volume of Cube (in. ³)
1		
2		
3		

- b.** Describe any relationships you see in the table.

- 14.** Describe how you can determine the volume of a cube when you do not have enough cubes to build the box.
- 15.** Use the variable e to represent the length of the edge of a cube. Write a rule, in terms of e , for calculating the volume of a cube.
- 16.** Determine the volume of a cube with edge length 8 inches.
- 17.** Now think about boxes that are rectangular prisms.
- a.** Complete this table. Use cubes to build boxes as needed.

Length (in.)	Width (in.)	Height (in.)	Volume (in. ³)
2	1	4	
4	3	2	
5	2	3	
3	4	5	

CONNECT TO AP

The process of gathering numerical information, making and testing conjectures, and generalizing the information into formulas is a key component of all math courses.

Volume and Surface Area of Rectangular Prisms

All Boxed Up

ACTIVITY 4.1

continued

SUGGESTED LEARNING STRATEGIES: Look for a Pattern, Create Representations, Identify a Subtask, RAFT

- b.** Describe any pattern you see in the table for finding the volume of rectangular prisms (on the previous page).
- c.** Use the variables l , w , and h to represent the length, width, and height of a box. Write a rule, in terms of l , w , and h , for finding the volume of a box.

- 18.** Elaine has a customer who needs a box with a volume of 12 cubic inches. The customer wants to know what size box is the least expensive to buy.
- The price will be based on surface area. The supplier charges $\frac{1}{2}$ cent per square inch.
 - The dimensions of the box are whole numbers.

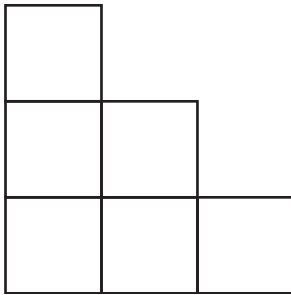
What size box do you recommend that Elaine's customer buy? Write a report to Elaine that shows your work and explains your recommendation.

My Notes

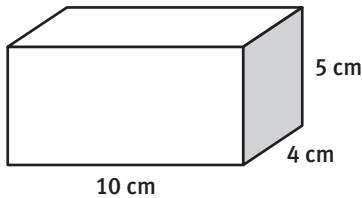
CHECK YOUR UNDERSTANDING

Write your answers on notebook paper.
Show your work.

- Determine whether the net can be cut out and folded to form a cube.

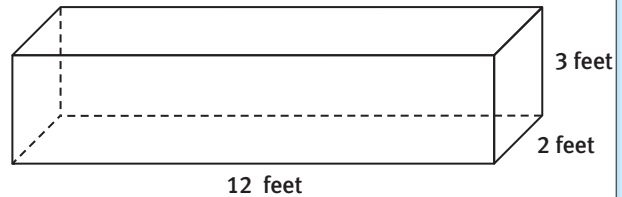


- What is the surface area of a cube that measures 4 cm on each edge?
- Determine the length of one edge of a cube that has a surface area of 864 square inches.
- Find the surface area of this prism.

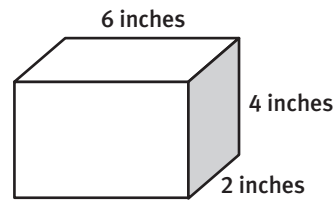


- A swimming pool, in the shape of a rectangular prism, is 50 meters long, 25 meters wide and 3 meters deep. A liter is the same as 0.001 cubic meters. How many liters of water are needed to completely fill the pool?

- Danny needs to buy sand for this box. He wants to nearly fill the box, leaving only 6 inches empty at the top. How much sand does Danny need?



- A hole shaped like a rectangular prism is 3 feet wide, 5 feet long, and 3 feet deep. If the hole is made 2 feet deeper, how much will the volume of the hole increase?
- What is the maximum number of cubes with a side length of 2 inches that can fit in this box?



- Determine the length of a rectangular prism whose width is 5 mm and whose height is 18 mm, if the volume of the prism is 540 mm^3 .
- MATHEMATICAL REFLECTION** You are to design a box that will hold 24 2-inch cubes. Describe two possible designs for the box if there is no empty space left in the box after you have put in all of the cubes. Sketch each of your designs and give their surface areas and volumes.

My Notes

Figure 1

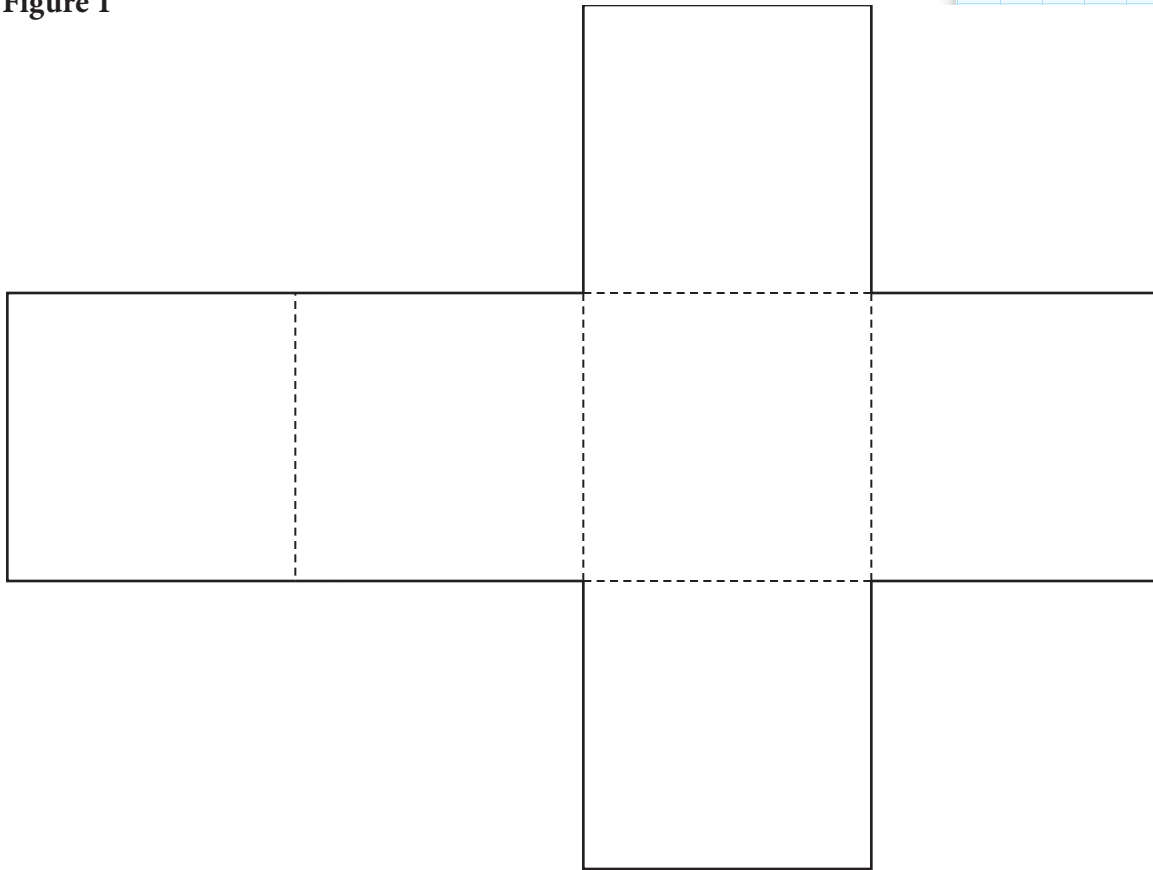


Figure 2

