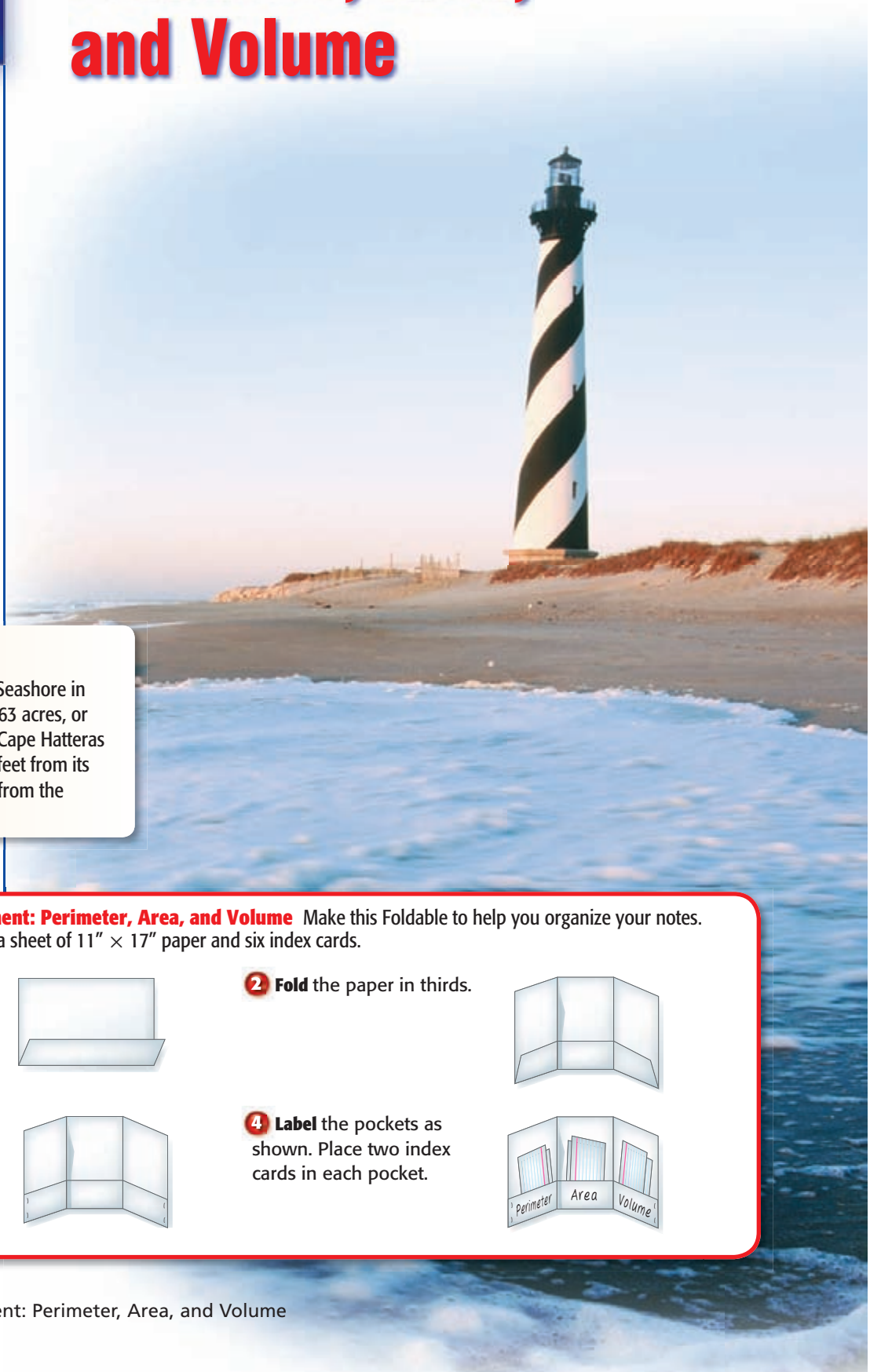
CHAPTER 10

Measurement: Perimeter, Area, and Volume



Indiana Academic Standards

6.3.3 Develop and use the formulas for the circumference and area of a circle.

6.3.5 Develop and use the formulas for the surface area and volume of a cylinder and find the surface area and volume of three-dimensional objects built from rectangular solids and cylinders.

Key Vocabulary

circle (p. 528)

circumference (p. 528)

volume (p. 548)

Real-World Link

Seashores Cape Hatteras National Seashore in North Carolina stretches across 31,263 acres, or about 49 square miles. In 1999, the Cape Hatteras lighthouse was moved inland 2,900 feet from its original location shown to protect it from the infringing ocean.

FOLDABLES Study Organizer

Measurement: Perimeter, Area, and Volume Make this Foldable to help you organize your notes. Begin with a sheet of 11″ × 17″ paper and six index cards.

1. **Fold** lengthwise about 3″ from the bottom.

2. **Fold** the paper in thirds.

3. **Open** and staple the edges on either side to form three pockets.

4. **Label** the pockets as shown. Place two index cards in each pocket.

GET READY for Chapter 10

Diagnose Readiness You have two options for checking Prerequisite Skills.

Option 2

IN Math Online Take the Online Readiness Quiz at glencoe.com.

Option 1

Take the Quick Quiz below. Refer to the Quick Review for help.

QUICK Quiz

Evaluate each expression. (Lesson 1-4)

1. $4(9)$
2. $4(17)$
3. $2(8) + 2(5)$
4. $2(16) + 2(11)$
5. **SHOPPING** Lou bought two pairs of pants and two shirts. If each pair of pants cost \$22 and each shirt cost \$13, how much did Lou spend?

Use the π button on your calculator to evaluate each expression. Round to the nearest tenth. (Prior Grade)

6. $\pi \times 7$
7. $\pi \times 12$
8. $2 \times \pi \times 8$
9. $2 \times \pi \times 13$

Evaluate each expression. (Lesson 1-4)

10. $16 \cdot 7$
11. $23 \cdot 5$
12. $\frac{8 \times 9}{2}$
13. $\frac{14 \times 11}{2}$
14. $10 \times 12 \times 8$
15. $33 \times 7 \times 5$
16. $(2)(3)(5) + (2)(3)(9) + (2)(5)(9)$
17. $(2)(8)(4) + (2)(8)(6) + (2)(4)(6)$
18. **BAKE SALE** Lucinda bought four packages of muffin mix. Each mix makes 12 muffins. If Lucinda sells each muffin for \$2, what is the most she could earn?

QUICK Review

Example 1

Evaluate 3(15) − 8.

$3(15) - 8 = 45 - 8$ Multiply.
$= 37$ Subtract.

Example 2

Evaluate 2(31) + 2(9).

$2(31) + 2(9) = 62 + 18$ Multiply.
$= 80$ Add.

Example 3

Use the π button on your calculator to evaluate 2 × π × 3. Round to the nearest tenth.

$2 \times \pi \times 3 = 6 \times \pi$ Multiply 2 by 3.
$= 18.8$ Multiply 6 by π.

Example 4

Evaluate $\frac{8 \times 4}{2}$.

$\frac{8 \times 4}{2} = \frac{32}{2}$ Multiply 8 by 4.
$= 16$ Divide 32 by 2.

Example 5

Evaluate (2)(9)(3) + (2)(9)(4) + (2)(3)(4).

$(2)(9)(3) + (2)(9)(4) + (2)(3)(4)$
$= 54 + 72 + 24$ Multiply.
$= 150$ Add.

Explore 10-1

Measurement Lab
Area and Perimeter

MAIN IDEA

Explore changes in area and perimeter of rectangles and squares.

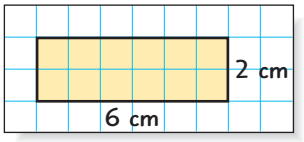
IN Academic Standards

Reinforcement of 5.3.5 Develop and use the formulas for the perimeter and area of triangles, parallelograms and trapezoids using appropriate units for measures. Find the area of complex shapes by dividing them into basic shapes.

If you increase the side lengths of a rectangle or square proportionally, how are the area and the *perimeter*, or distance around the rectangle, affected? In this lab, you will investigate relationships between the areas and perimeters of original figures and those of the similar figures.

ACTIVITY

STEP 1 On centimeter grid paper, draw and label a rectangle with a length of 6 centimeters and a width of 2 centimeters.



STEP 2 Find the area and perimeter of this original rectangle. Then record the information in a table like the one shown.

Rectangle	Length (cm)	Width (cm)	Area (sq cm)	Perimeter (cm)
original	6	2		
A	12	4		
B	18	6		
C	24	8		

STEP 3 Repeat Steps 1 and 2 for rectangles A, B, and C, whose dimensions are shown in the table.

Analyze the Results

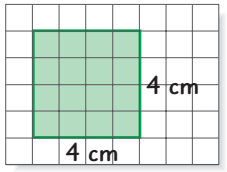
1. Describe how the dimensions of rectangles A, B, and C are different than the original rectangle.
2. Describe how the area of the original rectangle changed when the length and width were both doubled.
3. Describe how the perimeter of the original rectangle changed when the length and width were both doubled.
4. How did the area and the perimeter of the original rectangle change when the length and width were both tripled? quadrupled?
5. Compare the areas and perimeters of the original rectangle and a rectangle with dimensions of 3 centimeters and 4 centimeters.

6. Draw a rectangle with a length and width that are half those of the original rectangle. Describe how the area and perimeter changes.

7. **MAKE A CONJECTURE** How are the perimeter and area of a rectangle affected if the length and the width are changed proportionally?

ACTIVITY

2 **STEP 1** On centimeter grid paper, draw and label a square with a length of 4 centimeters.



STEP 2 Find the area and perimeter of this original square. Then record the information in a table like the one shown.

Square	Side Length (cm)	Area (sq cm)	Perimeter (cm)
original	4		
A	5		
B	6		
C	7		

STEP 3 Repeat Steps 1 and 2 for squares A, B, and C, whose dimensions are shown in the table.

Study Tip

Look Back You can review **area of squares** in Lesson 1-9.

ANALYZE THE RESULTS

8. Describe how the dimensions of squares A, B, and C are different from the original square.

9. Describe how the perimeter of the original square changed when the side lengths increased by one centimeter.

10. Compare the ratios $\frac{\text{perimeter}}{\text{side length}}$ in the table above.

11. Suppose the perimeter of a square is 60 centimeters. Explain how you can use the ratio in Exercise 10 to find the length of its side. Then find its side length.

12. **WRITE A FORMULA** If P represents the perimeter of a square, write an equation that describes the relationship between the square's side length s and perimeter P. Compare this equation to the formula for a square's area.

13. **MAKE A CONJECTURE** Suppose you double the side lengths of the orginal square. Use what you learned in Activity 1 to predict the area and perimeter of the new square. Explain your reasoning.

10-1 Perimeter

MAIN IDEA

Find the perimeters of squares and rectangles.

IN Academic Standards

Reinforcement of 5.3.5 Develop and use the formulas for the perimeter and area of triangles, parallelograms and trapezoids using appropriate units for measures. Find the area of complex shapes by dividing them into basic shapes.

New Vocabulary

perimeter

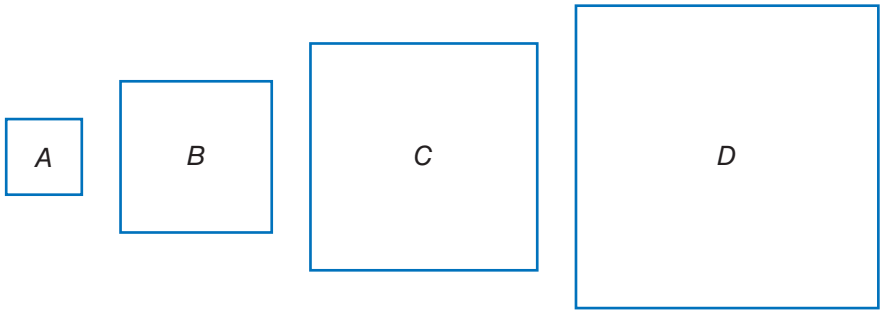
IN Math Online

glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

MINI Lab

STEP 1 Use a centimeter ruler to measure the side length of each square shown below. Round each to the nearest centimeter.



STEP 2 Copy and complete the table below. Find the distance around each square by adding the measures of its sides.

Square	Side Length	Distance Around
A		
B		
C		
D		

1. Write the ratio $\frac{\text{distance around}}{\text{side length}}$ in simplest form for squares A through D. What do you notice about these ratios?
2. **MAKE A CONJECTURE** Write an expression for the distance around a square that has a side length of x centimeters.

The distance around any closed figure is called its **perimeter**. As you discovered in the Mini Lab above, you can multiply the measure of any side of a square by 4 to find its perimeter.

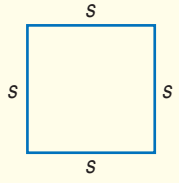
Perimeter of a Square

Key Concept

Words The perimeter P of a square is four times the measure of any of its sides s.

Symbols $P = 4s$

Model



Real-World Link . . . . . .
In 1964, indoor volleyball became an Olympic sport. Beach volleyball followed many years later in 1996.

Real-World EXAMPLE Perimeter of a Square

1 **VOLLEYBALL** **In volleyball, the shape of the court on one side of the net is a square with a side length of 9 meters. What is the perimeter of one half of a volleyball court?**

$P = 4s$ Perimeter of a square

$P = 4(9)$ Replace s with 9.

$P = 36$ Multiply.

The perimeter of one half of a volleyball court is 36 meters.

CHECK Your Progress

a. **SOFTBALL** The infield of a softball field is a square that measures 60 feet on each side. What is the perimeter of the infield?

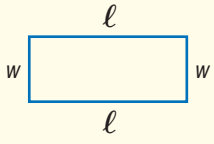
Perimeter of a Rectangle

Key Concept

Words The perimeter P of a rectangle is the sum of the lengths and widths. It is also two times the length ℓ plus two times the width w.

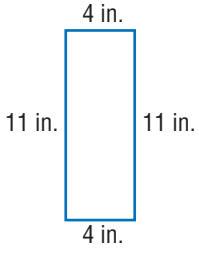
Symbols $P = \ell + w + \ell + w$
$P = 2\ell + 2w$

Model



EXAMPLE Perimeter of a Rectangle

2 **Find the perimeter of the rectangle.**



$P = 2\ell + 2w$ Write the formula.

$P = 2(11) + 2(4)$ Replace ℓ with 11 and w with 4.

$P = 22 + 8$ Multiply.

$P = 30$ Add.

The perimeter is 30 inches.

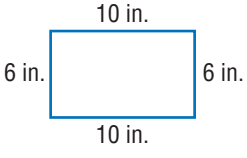
Study Tip

Check You can check your answer in Example 2 by finding the sum of the lengths and widths of the rectangle. $P = 11 + 4 + 11 + 4$ or 30 inches. So, the answer is correct.

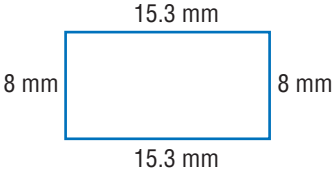
CHECK Your Progress

Find the perimeter of each rectangle.

b.



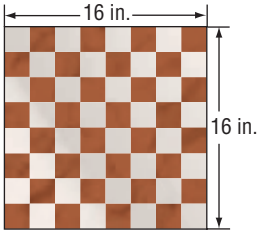
c.



CHECK Your Understanding

Example 1 (p. 523)

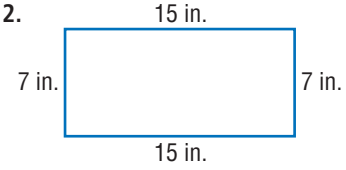
1. **CHESS** The game of chess is played on a square-shaped board. What is the perimeter of the chess board shown?



Example 2 (p. 523)

Find the perimeter of each rectangle.

2.



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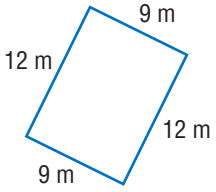

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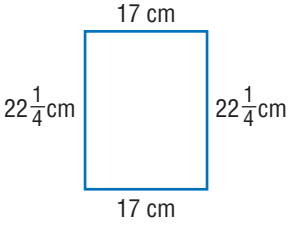


Practice and Problem Solving

HOMEWORK HELP

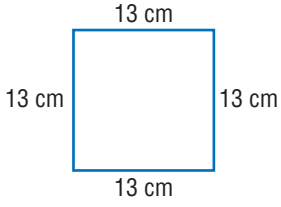
For Exercises	See Examples
5–8	1
9–12	2

5. **SIGNS** A typical *Do Not Enter* sign is 750 millimeters on each side. What is the perimeter of the sign?

6. **COUNTY** Gray County is an approximate square with each side measuring 30 miles. What is the approximate perimeter of Gray County?

Find the perimeter of each square or rectangle.

7.



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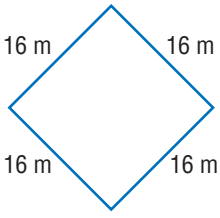

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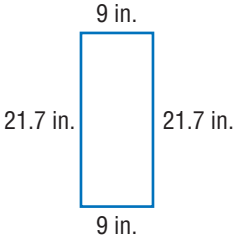

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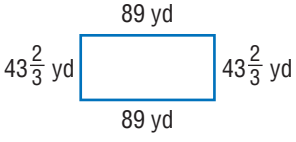

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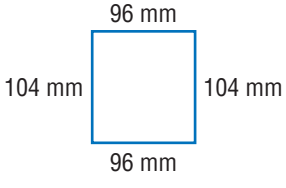

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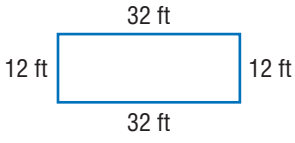
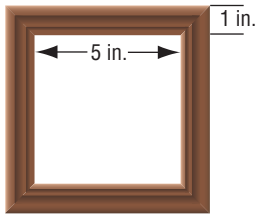
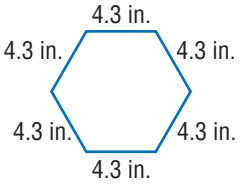


13. **FRAMES** Nadia has a square picture frame that will hold a 5-inch by 5-inch photo. The picture frame has a border that is 1 inch thick all the way around. How much larger is the perimeter of the frame than the perimeter of the picture?



Find the perimeter of each figure.

14.



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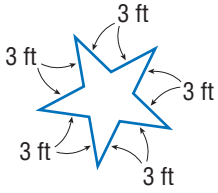

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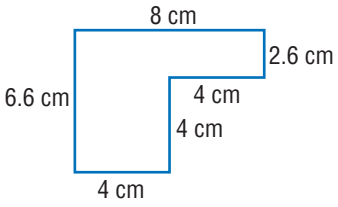
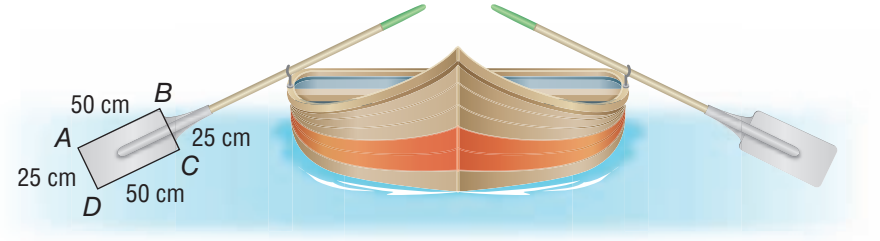


Real-World Link...
Rowing teams keep the oars on each side of the boat parallel to optimize speed and performance.

17. ROWING The blades of the oars shown are quadrilaterals. What is the perimeter of quadrilateral *ABCD*?

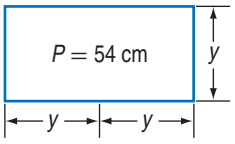


18. BASKETBALL A basketball court measures 26 meters by 14 meters. Ten meters of seating is added to each side of the court. Find the perimeter of the rectangle enclosed by the court and the seating area.

19. SEWING A lace border will be sewn on square pillows. The amount of lace needed for one pillow is $58\frac{1}{2}$ inches. What is the length of the pillow?

For Exercises 20 and 21, find the value of y given the perimeter P.

20.



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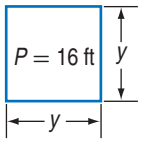


Academic Standards • ISTEP+
Extra Practice, pp. 698, 715

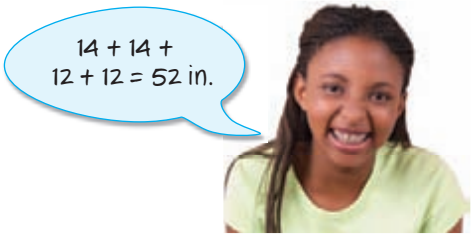
H.O.T. Problems

22. OPEN ENDED Draw a quadrilateral that has a perimeter of 20 centimeters.

23. REASONING Are two rectangles with equal perimeters always congruent? Explain your reasoning.

24. FIND THE ERROR Daquan and Jasmine are finding the perimeter of a rectangle that is 14 inches by 12 inches. Who is correct? Explain.

Daquan



Jasmine

25. CHALLENGE Find and compare the perimeters of the rectangles whose dimensions are listed in the table. Then create another set of at least three rectangles that share a similar relationship.

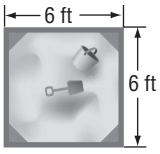
Length (ft)	Width (ft)
6	1
5	2
4	3

26. **WRITING IN MATH** Compare and contrast the formulas for the perimeter of squares and rectangles.

ISTEP+ PRACTICE

Reinforcement of 5.3.5

27. Mr. Johnson is building a bottomless square sandbox using cedar wood.



Which method can Mr. Johnson use to find the amount of cedar needed to build the sandbox?

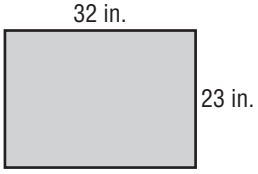
A Multiply the length of a side by 2.

B Multiply the length of a side by 4.

C Square the length of a side.

D Multiply the length of each side by 2 and add the result.

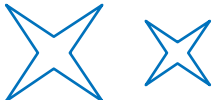
28. **SHORT RESPONSE** Francisco cut a rectangle out of construction paper for a geometry project.

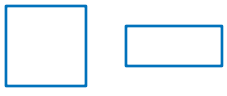


Find the perimeter of the rectangle in inches.

Spiral Review

Tell whether each pair of figures is *congruent, similar,* or *neither.* (Lesson 9-7)

29. 

30. 

31. 

32. **TRAVEL** Chayton lives in Glacier and works in Alpine. There is no direct route from Glacier to Alpine, so Chayton drives through either Elm or Perth. How many different ways can he drive to work? Use the *draw a diagram* strategy. (Lesson 9-6)

Estimate each percent. (Lesson 7-8)

33. 31% of 157

34. 74% of 45

35. 33% of 92

36. **BUSINESS** The table shows the choices available when ordering a pie from the Taste-n-Tell Bakery. How many different pies are available? (Lesson 7-5)

Taste-n-Tell Bakery	
flavor	apple cherry peach
crust	single double
size	medium large

GET READY for the Next Lesson

PREREQUISITE SKILL **Round each number to the nearest tenth.** (Lesson 3-3)

37. 43.363

38. 9.8767

39. 37.6219

40. 42.961

Explore 10-2

Measurement Lab
Circumference

MAIN IDEA

Describe the relationship between the diameter and circumference of a circle.

IN Academic Standards

6.3.3 Develop and use **the formulas for the circumference** and area **of a circle.**

In this investigation, you will discover the relationship between the distance around a circle (circumference), and the distance across a circle through its center (diameter).

ACTIVITY

STEP 1 Make a table like the one shown.

Object	C	d	$\frac{C}{d}$

STEP 2 Cut a piece of string the length of the distance C around a circular object such as a jar lid. Use a centimeter ruler to measure the length of the string to the nearest tenth of a centimeter.

STEP 3 Measure the distance d across the lid. Record this measurement in the table.

STEP 4 Use a calculator to find the ratio of the distance around each circle to the distance across the circle.

STEP 5 Repeat steps 2 though 4 for several other circular objects.

Analyze the Results

1. **MAKE A CONJECTURE** If you know the diameter of a circle, how can you find the distance around the circle?
2. **MAKE A PREDICTION** What would be the approximate distance around a circle that is 4 inches across?
3. **MAKE A CONJECTURE** How can you find the distance around a circle if you know the distance from the center of the circle to the edge of the circle?

10-2 Circles and Circumference

MAIN IDEA

Estimate and find the circumference of circles.

IN Academic Standards

6.3.3 Develop and use **the formulas for the circumference** and area **of a circle.** **P.6.4** Determine appropriate accuracy and precision of measurement in problem situations.

New Vocabulary

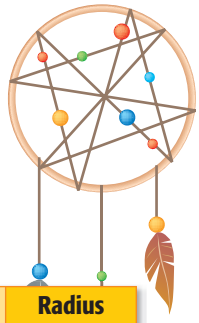
circle
center
chord
diameter
circumference
radius

IN Math Online

glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

GET READY for the Lesson

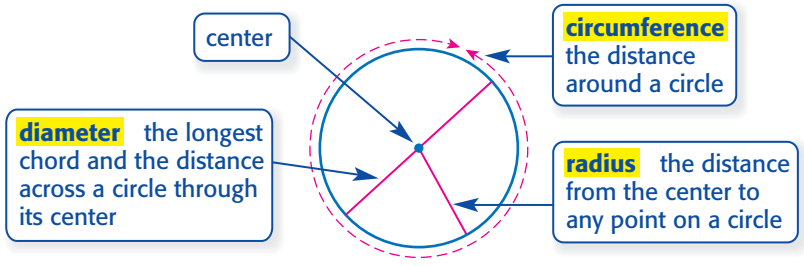


DREAMCATCHERS The table shows the approximate distance around (circumference), the distance across through the center (diameter), and the distance from the center to the edge (radius) of several dreamcatchers.

1. Describe the relationship between the diameter and radius of each hoop.
2. Describe the relationship between the circumference and diameter of each hoop.

Circumference (in.)	Diameter (in.)	Radius (in.)
9.4	3	1.5
37.7	12	6
62.8	20	10

A **circle** is the set of all points in a plane that are the same distance from a point called the **center**. A **chord** is any segment with both endpoints on the circle.



Radius and Diameter

Key Concept

Words The diameter d of a circle is twice its radius r. The radius r of a circle is half of its diameter d.

Symbols $d = 2r$ $\quad r = \frac{d}{2}$

EXAMPLES Find the Radius and Diameter

1 **The diameter of a circle is 14 inches. Find the radius.**

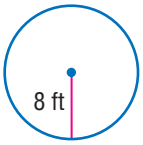
$r = \frac{d}{2}$ Radius of circle

$r = \frac{14}{2}$ Replace d with 14.

$r = 7$ Divide.

The radius is 7 inches.

2 **The radius of a circle is 8 feet. Find the diameter.**



$d = 2r$ Diameter of circle

$d = 2 \cdot 8$ Replace r with 8.

$d = 16$ Multiply.

The diameter is 16 feet.

CHECK Your Progress

Find the radius or diameter of each circle with the given dimension.

a. $d = 23$ cm **b.** $r = 3$ in. **c.** $d = 16$ yd

Study Tip

Pi The exact value of pi never ends, but it is often approximated as 3 or 3.14.

The circumference of a circle is always a little more than three times its diameter. The exact number of times is represented by the Greek letter π (pi). The exact value of π is 3.1415926....

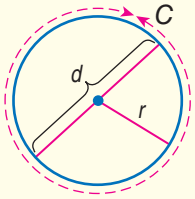
Circumference

Key Concept

Words The circumference of a circle is equal to π times its diameter or π times twice its radius.

Symbols $C = \pi d$ or $C = 2\pi r$

Model

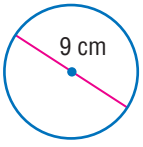


You can estimate the circumference of a circle by rounding the value of π to 3. The exact value of π is more accurate than the estimate, 3.

EXAMPLES Estimate the Circumference

Estimate the circumference of each circle.

3



The diameter of the circle is 9 centimeters.

$C = \pi d$ Circumference of circle

$C \approx 3 \cdot 9$ Replace π with 3 and d with 9.

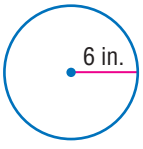
$C \approx 27$ Multiply.

The circumference is about 27 centimeters.

Reading Math

Symbols The symbol ≈ means *approximately equal to.*

4



The radius of the circle is 6 inches.

$C = 2\pi r$ Circumference of circle

$C \approx 2 \cdot 3 \cdot 6$ Replace π with 3 and r with 6.

$C \approx 36$ Multiply.

The circumference is about 36 inches.

CHECK Your Progress

d. $d = 7$ in. **e.** $r = 5$ ft **f.** $r = 12$ mm

EXAMPLE 5 Find Circumference

Find the circumference of a circle with a diameter of 4 inches. Round to the nearest tenth.

METHOD 1 Use 3.14.

$C = \pi d$

$C \approx (3.14)(4)$

$C \approx 12.56$

METHOD 2 Use a calculator.

$C = \pi d$

$C = \pi \cdot 4$

$C \approx$ 2nd [π] × 4 ENTER

≈ 12.56637061

To the nearest tenth, the circumference is 12.6 inches.

Study Tip

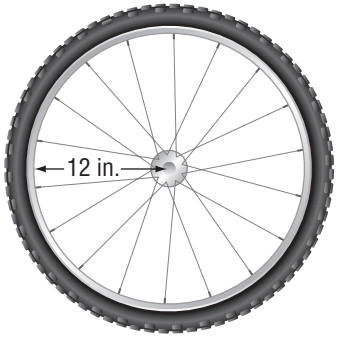
Check for Reasonableness In Example 5, since $3 \times 4 = 12$ and 12.6 is close to 12, the answer is reasonable.

CHOOSE Your Method

g. Find the circumference of a circle with a diameter of 15 meters. Round to the nearest tenth.

ISTEP+ EXAMPLE 6 6.3.3

A bicycle wheel has spokes for support. Each spoke extends from the center of the wheel to the rim. Which method can be used to find the circumference of the bicycle wheel?



A Multiply the diameter by π and by 2.

B Divide the diameter by π.

C Multiply the radius by π.

D Multiply the radius by π and by 2.

Test-Taking Tip

Formulas Many standardized tests have a list of formulas you may need to solve problems. However, it is always a good idea to familiarize yourself with the formulas before taking the test.

Read the Item You need to find the circumference of the bicycle tire. You know the radius of the wheel.

Solve the Item Use the formula for the circumference of a circle, $C = 2\pi r$. The formula states that the circumference of a circle is equal to 2 times π times the radius. So, the answer is D.

CHECK Your Progress

h. An above-ground circular swimming pool is 18 feet in diameter. How does the pool's diameter d compare to its circumference C?

F $d \approx \frac{1}{2}C$

G $d \approx 2C$

H $d \approx 3C$

J $d \approx \frac{1}{3}C$

CHECK Your Understanding

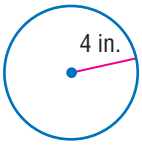
Examples 1, 2 (pp. 528–529)

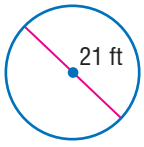
Find the radius or diameter of each circle with the given dimension.

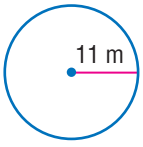
1. $d = 3$ m
2. $r = 14$ ft
3. $d = 20$ in.

Examples 3, 4 (p. 529)

Estimate the circumference of each circle.

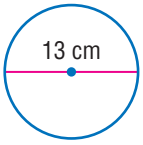
4. 

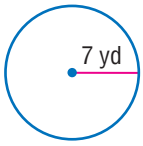
5. 

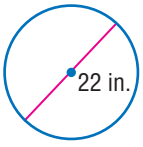
6. 

Example 5 (p. 530)

Find the circumference of each circle. Round to the nearest tenth.

7. 

8. 

9. 

Example 6 (p. 530)

10. **MULTIPLE CHOICE** Paul knows the circumference of Earth around the Equator but would like to find the radius. Which method can Paul use to find the radius of Earth?

A Multiply the circumference by the diameter.

B Divide the circumference by π and then divide by 2.

C Multiply the circumference by π.

D Divide the circumference by π and then multiply by 2.

Practice and Problem Solving

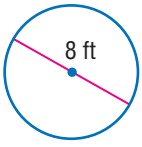
HOMEWORK HELP

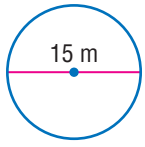
For Exercises	See Examples
11–14	1, 2
15–20	3, 4
21–28	5
38, 39	6

Find the radius or diameter of each circle with the given dimensions.

11. $d = 5$ mm
12. $d = 24$ ft
13. $r = 17$ cm
14. $r = 36$ in.

Estimate the circumference of each circle.

15. 

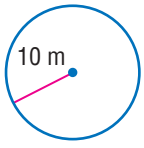
16. 

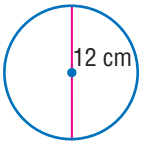
17. 

18. $r = 15$ yd
19. $d = 13$ ft
20. $d = 27$ cm

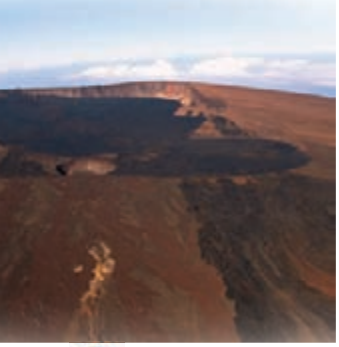
Find the circumference of each circle. Round to the nearest tenth.

21. 

22. 

23. 

24. $d = 28$ ft
25. $r = 21$ mm
26. $r = 35$ in.



Real-World Link
In California and Oregon, many shield volcanoes have diameters of three or four miles.
Source: U.S. Geological Survey

27. **MUSIC** The diameter of a music CD is 12 centimeters. Find the circumference of a CD to the nearest tenth.

28. **VOLCANOES** The Belknap shield volcano is located in Oregon. The volcano is circular and has a diameter of 5 miles. What is the circumference of this volcano to the nearest tenth?

29. **TREES** The largest tree in the world by volume is The General Sherman Tree in Sequoia National Park. The diameter at the base is 36 feet. If a person with outstretched arms can reach 6 feet, how many people would it take to reach around the base of the tree?

30. **WALKING** At a local park, Dawn can choose between two circular paths to walk. One path has a diameter of 120 yards, and the other has a radius of 45 yards. How much farther can Dawn walk on the longer path than the shorter path if she walks around the path once?

31. **ESTIMATION** Without calculating, determine if the circumference of a circle with a radius of 4 feet will be greater or less than 24 feet. Explain your reasoning.

32. **FIND THE DATA** Refer to the Data File on pages 16–19. Choose some data and write a real-world problem in which you would estimate the circumference of a circular object.

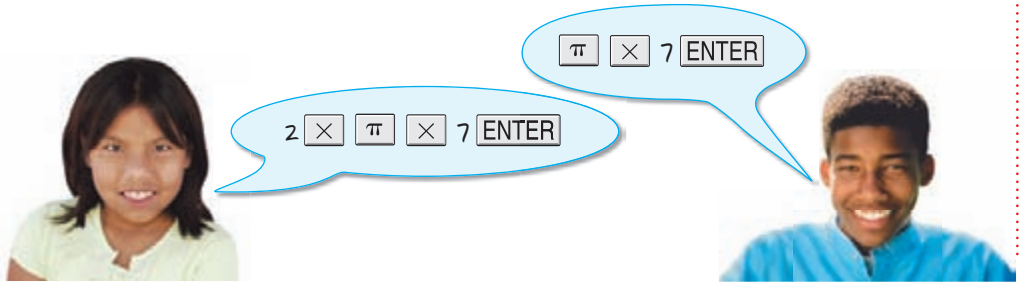
33. **ESTIMATION** Catalina is giving pillar candles as favors at her birthday party. She wants to glue a piece of ribbon around each candle. The diameter of each candle is 4 inches. She has 8 candles and 2 yards of ribbon. Does she have enough ribbon? Explain.

Academic Standards • ISTEP+
Extra Practice, pp. 698, 715

H.O.T. Problems

34. **REASONING** *Accuracy* describes how close a measurement is to its actual value. *Precision* is the ability of a measurement to be consistently reproduced. Three different students measured the circumference of the same circle. Their results were 18.6 centimeters, 18.4 centimeters, and 18.5 centimeters. If the diameter of the circle is 6 centimeters, describe both the precision and accuracy of their measurements.

35. **FIND THE ERROR** Bena and Orlando are using a calculator to find the circumference of a circle with a radius of 7 inches. Who entered the correct keystrokes to find the circumference? Explain your reasoning.



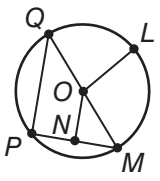
Bena Orlando

36. **CHALLENGE** Analyze how the circumference of a circle would change if the diameter was doubled. Provide an example to support your explanation.

37. **WRITING IN MATH** Explain how you could estimate the diameter of a circle with a circumference of 15.7 meters.

ISTEP+ PRACTICE 6.3.3

38. A circle with center at point O is shown below.



Which line segment is half the length of diameter QM?

A Segment ON **C** Segment QP

B Segment PM **D** Segment OL

39. The circumference of the Ferris wheel at the county fair is stated in the local newspaper. Which method can you use to find the diameter of the Ferris wheel?

F Multiply the circumference by π.

G Multiply the circumference by 2 and divide by the radius.

H Divide the circumference by π.

J Divide the circumference by the radius and multiply by 2.

Spiral Review

Find the perimeter of each rectangle with the dimensions given. (Lesson 10-1)

40. 4 inches by 7 inches

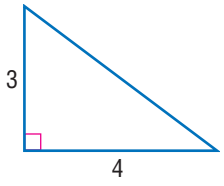
41. 15 feet by 17 feet

42. 17 yards by 24 yards

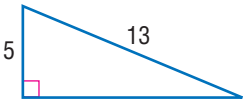
43. 25 miles by 15 miles

State whether each triangle is similar to triangle XYZ. (Lesson 9-7)

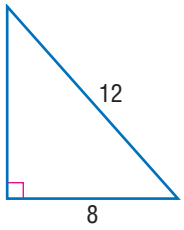
44.

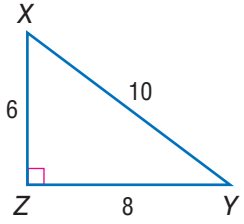


45.



46.





47. **GAMES** At the county fair, Alejandra tosses a beanbag onto an alphabet board. It is equally likely that the bag will land on any letter. Find the probability that the beanbag will land on one of the letters in her name. (Lesson 7-4)

48. **BABYSITTING** Arianna started babysitting at 5:30 P.M. The children's parents were home at 9:15 P.M. How long did Arianna babysit? (Lesson 8-7)

GET READY for the Next Lesson

PREREQUISITE SKILL **Multiply.** (Page 744)

49. 6×17

50. 11×13

51. 20×9

52. 18×27

10-3 Area of Parallelograms

MAIN IDEA

Find the areas of parallelograms.

IN Academic Standards

Reinforcement of 5.3.5 Develop and use the formulas for the perimeter and area of triangles, parallelograms and trapezoids using appropriate units for measures. Find the area of complex shapes by dividing them into basic shapes.

New Vocabulary

base
height

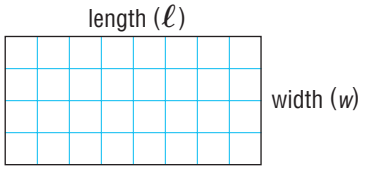
IN Math Online

glencoe.com

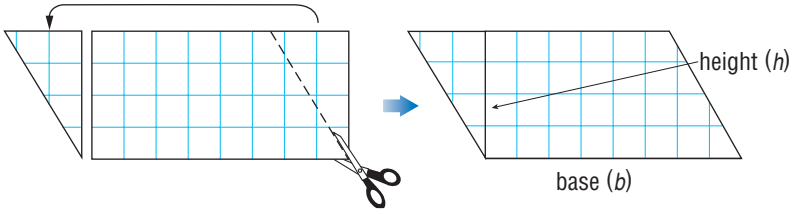
- Extra Examples
- Personal Tutor
- Self-Check Quiz

MINI Lab

STEP 1 Draw and then cut out a rectangle as shown.



STEP 2 Cut a triangle from one side of the rectangle and move it to the other side to form a parallelogram.



STEP 3 Repeat Steps 1 and 2 with two other rectangles of different dimensions on grid paper.

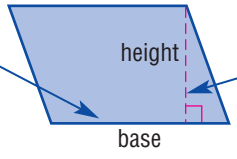
STEP 4 Copy and complete the table below using the three rectangles and three corresponding parallelograms you created.

	Length (ℓ)	Width (w)		Base (b)	Height (h)
Rectangle 1			Parallelogram 1		
Rectangle 2			Parallelogram 2		
Rectangle 3			Parallelogram 3		

1. How does a parallelogram relate to a rectangle?
2. What part of the parallelogram corresponds to the length of the rectangle?
3. What part corresponds to the rectangle's width?
4. **MAKE A CONJECTURE** What is the formula for the area of a parallelogram?

In the Mini Lab, you discovered how the area of a parallelogram is related to the area of a rectangle.

The **base** of a parallelogram can be any one of its sides.



The **height** is the distance from the base to the opposite side.

To find the area of a parallelogram, multiply the measures of the base and the height.

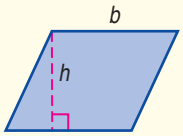
Area of a Parallelogram

Key Concept

Words The area A of a parallelogram is the product of any base b and its height h.

Symbols $A = bh$

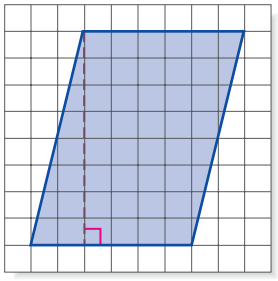
Model



EXAMPLES Find Areas of Parallelograms

Find the area of each parallelogram.

1



The base is 6 units, and the height is 8 units.

$A = bh$ Area of parallelogram

$A = 6 \cdot 8$ Replace b with 6 and h with 8.

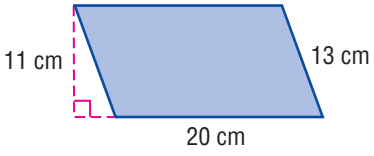
$A = 48$ Multiply.

The area is 48 square units or 48 units^2.

Reading Math

Area Measurement
An area measurement can be written using abbreviations and an exponent of 2.
For example:
square units = units^2
square inches = in^2
square feet = ft^2
square meters = m^2

2



Estimate $A \approx 20 \cdot 10$ or 200 cm^2

$A = bh$ Area of parallelogram

$A = 20 \cdot 11$ Replace b with 20 and h with 11.

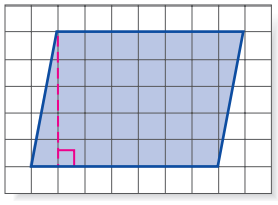
$A = 220$ Multiply.

The area is 220 square centimeters or 220 cm^2.

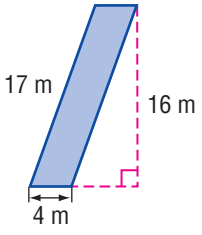
Check for Reasonableness Compare 220 with the estimate. $220 \approx 200$ ✔

CHECK Your Progress

a.



b.

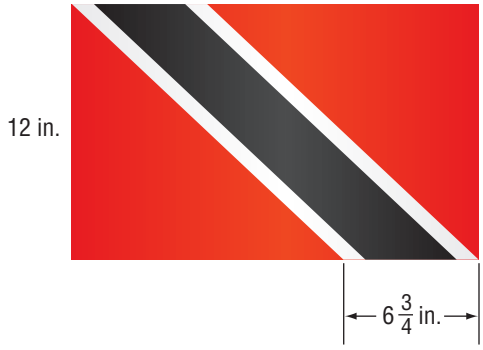


Study Tip

Height of Parallelograms
For the parallelogram formed by the area shaded black in Example 3, its height, 12 inches, is labeled *outside* the parallelogram.

Real-World EXAMPLE

3 **FLAGS** **Romilla is doing a research project on the nation of Trinidad and Tobago. Part of the project is to paint a replica of the nation's flag. Find the area of the flag that is not red.**



The area of the flag that is not red is shaped like a parallelogram, so use the formula $A = bh$.

$A = bh$ Area of parallelogram

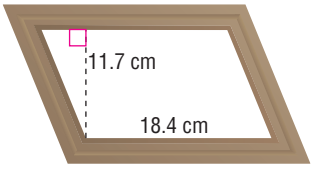
$A = 6\frac{3}{4} \cdot 12$ Replace b with $6\frac{3}{4}$ and h with 12.

$A = 81$ $6\frac{3}{4} \cdot 12 = \frac{27}{4} \cdot 12$, or 81

The area of the flag that is not red is 81 square inches.

CHECK Your Progress

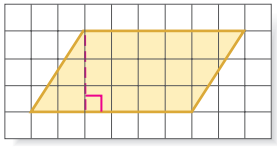
c. **ART** Guadalupe and her dad made parallelogram-shaped picture frames to display some of her artwork. Find the area of the artwork that will be visible in each picture frame.

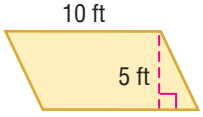


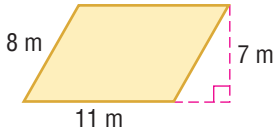
CHECK Your Understanding

Examples 1, 2 (p. 535)

Find the area of each parallelogram.

1. 

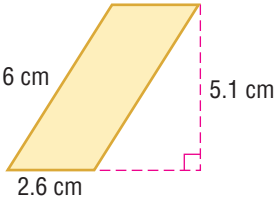
2. 

3. 

Example 3 (p. 536)

4. Find the area of a parallelogram with base 15 yards and height $21\frac{2}{3}$ yards.

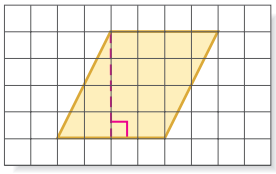
5. **TANGRAMS** The size of the parallelogram piece in a set of tangrams is shown at the right. Find the area of the piece.

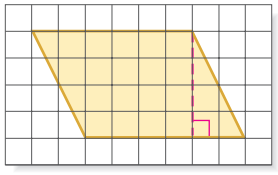


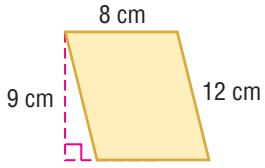
Practice and Problem Solving

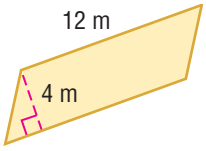
HOMEWORK HELP	
For Exercises	See Examples
6–11	1, 2
12–15	3

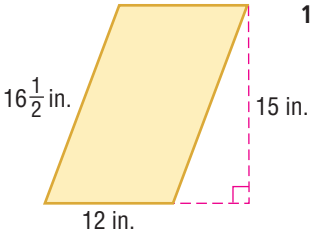
Find the area of each parallelogram.

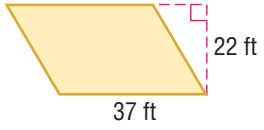
6. 

7. 

8. 

9. 

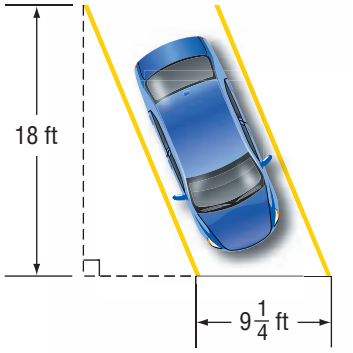
10. 

11. 

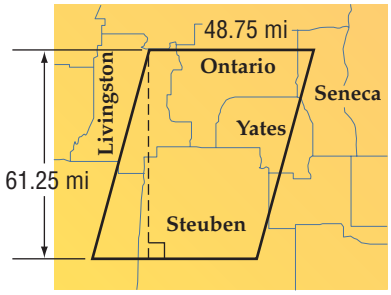
12. Find the area of a parallelogram with base 24 feet and height $2\frac{1}{4}$ feet.

13. Find the area of a parallelogram with base 6.75 meters and height 4.8 meters.

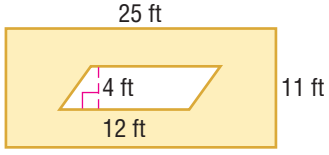
14. **PARKING** Find the area of the parking space below.

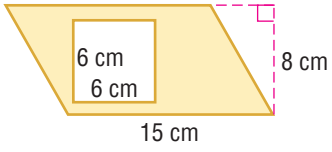


15. **MAPS** What is the area of the region shown on the map?



Find the area of the shaded region in each figure.

16. 

17. 

18. **BUILDINGS** The base of a building is shaped like a parallelogram. The first floor has an area of 20,000 square feet. If the base of this parallelogram is 250 feet, can its height be 70 feet? Explain.

19. **ANALYZE TABLES** An architect designed three different parallelogram-shaped brick patios. Find the missing dimensions in the table.

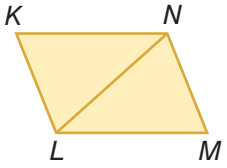
Patio	Base (ft)	Height (ft)	Area (ft^2)
1	$15\frac{3}{4}$	■	147
2	■	$11\frac{1}{4}$	$140\frac{5}{8}$
3	$10\frac{1}{4}$	■	$151\frac{3}{16}$

Academic Standards • ISTEP+

Extra Practice, pp. 698, 715

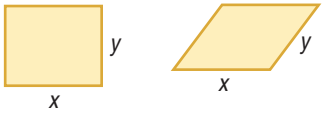
H.O.T. Problems

20. **REASONING** Refer to parallelogram *KLMN* at the right. If the area of parallelogram *KLMN* is 35 square inches, what is the area of triangle *KLN*?



21. **OPEN ENDED** On grid paper, draw three different parallelograms that each have an area of 24 units and a height of 4 units. Compare and contrast the parallelograms.

22. **CHALLENGE** If $x = 5$ and $y < x$, which figure has the greater area? Explain your reasoning.



23. **WRITING IN MATH** Explain how the formula for the area of a parallelogram is related to the formula for the area of a rectangle.

ISTEP+ PRACTICE

Reinforcement of 5.3.5

24. Robert used a piece of poster board shaped like a parallelogram to make a sign for his campaign as class president. The base of the poster board is 52 inches, and the area is 1,872 square inches. Find the height of the poster board.

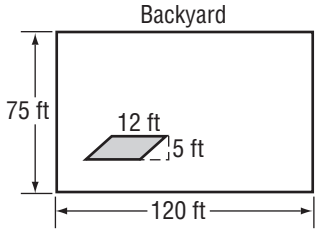
A 884 in.

B 176 in.

C 42 in.

D 36 in.

25. A family has a flower garden in the shape of a parallelogram in their backyard. They planted grass in the rest of the yard. What is the area of the backyard that is planted with grass?



F 390 sq ft

G 8,940 sq ft

H 9,060 sq ft

J 9,144 sq ft

Spiral Review

Estimate the circumference of each circle. (Lesson 10-2)

26. $d = 15$ in.

27. $r = 19$ m

28. $d = 6$ ft

29. **MONUMENTS** The Lincoln Memorial is a rectangular structure whose base is 188 feet by 118 feet. What is the perimeter of the base of the Lincoln Memorial? (Lesson 10-1)

GET READY for the Next Lesson

PREREQUISITE SKILL **Find the value of each expression.** (Lesson 1-4)

30. $\frac{6 \times 3}{2}$

31. $\frac{5 \times 12}{2}$

32. $\frac{7 \times 8}{2}$

33. $\frac{14 \times 12}{2}$

Explore 10-4

Measurement Lab
Area of Triangles

MAIN IDEA

Discover the formula for the area of a triangle using the properties of parallelograms and a table of values.

IN Academic Standards

Reinforcement of 5.3.5 Develop and use the formulas for the perimeter and area of triangles, parallelograms and trapezoids using appropriate units for measures. Find the area of complex shapes by dividing them into basic shapes.

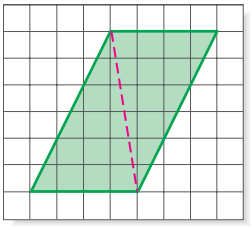
In this investigation, you will discover the formula for the area of a triangle using the properties of parallelograms and a table of values.

ACTIVITY

STEP 1 Copy the table shown.

Parallelogram	Base, b	Height, h	Area of Parallelogram	Area of Each Triangle
A	4	6		
B	2	5		
C	3	4		
D	5	3		
E	7	5		

STEP 2 Draw Parallelogram A on grid paper using the dimensions given in the table.



STEP 3 Draw a diagonal as shown.

STEP 4 Cut out the parallelogram. Then calculate its area. Record this measure in the table.

STEP 5 Cut along the diagonal to form two triangles.

Analyze the Results

1. Compare the base and height of each triangle to the base and height of the original parallelogram. What do you notice?
2. Compare the two triangles formed. How are they related?
3. What is the area of each triangle? Record your answer in the table.
4. Repeat Steps 2 through 5 for Parallelograms B through E. Calculate the area of each triangle formed and record your results in the table.
5. **LOOK FOR A PATTERN** What patterns do you notice in the rows of the table?
6. **MAKE A CONJECTURE** Write a formula that relates the area A of a triangle to the length of its base b and height h.

10-4 Area of Triangles

MAIN IDEA

Find the areas of triangles.

IN Academic Standards

Reinforcement of 5.3.5 Develop and use the formulas for the perimeter and area of triangles, parallelograms and trapezoids using appropriate units for measures. Find the area of complex shapes by dividing them into basic shapes.

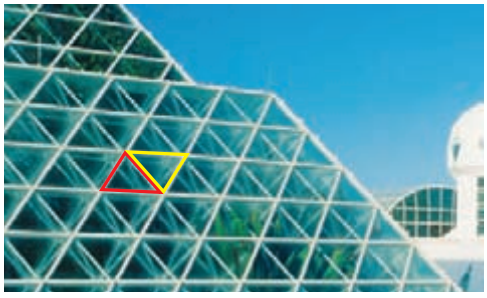
IN Math Online

glencoe.com

- Concepts in Motion
- Extra Examples
- Personal Tutor
- Self-Check Quiz

GET READY for the Lesson

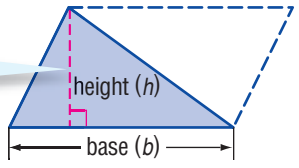
BIOSPHERE The structure of the different sections in the Biosphere 2 complex in Tucson, Arizona, are made of interlocking triangles that are all the same size.



1. Compare the two outlined triangles.
2. What figure is formed by the two triangles?
3. **MAKE A CONJECTURE** Describe the relationship that exists between the area of one triangle and the area of the parallelogram.

A parallelogram can be formed by two congruent triangles. Since congruent triangles have the same area, the area of a triangle is one half the area of the parallelogram.

The base of a triangle can be any one of its sides. The height is the shortest distance from a base to the opposite vertex.



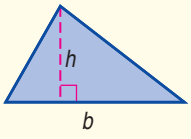
Area of a Triangle

Key Concept

Words The area A of a triangle is one half the product of the base b and its height h.

Symbols $A = \frac{1}{2}bh$ or $A = \frac{bh}{2}$

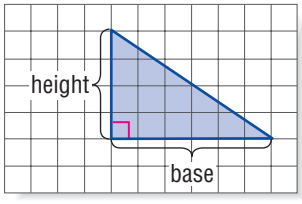
Model



EXAMPLES Find the Area of a Triangle

Find the area of each triangle.

1



By counting, you find that the measure of the base is 6 units and the height is 4 units.

Study Tip

Mental Math You can use mental math to multiply $\frac{1}{2}(6)(4)$. Think: Half of 6 is 3, and 3×4 is 12.

$A = \frac{1}{2}bh$ Area of a triangle

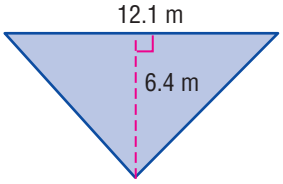
$A = \frac{1}{2}(6)(4)$ Replace b with 6 and h with 4.

$A = \frac{1}{2}(24)$ Multiply.

$A = 12$ Multiply.

The area of the triangle is 12 square units.

2



$A = \frac{1}{2}bh$ Area of a triangle

$A = \frac{1}{2}(12.1)(6.4)$ Replace b with 12.1 and h with 6.4.

$A = \frac{1}{2}(77.44)$ Multiply.

$A = 38.72$ Divide. $\frac{1}{2}(77.44) = 77.44 \div 2$, or 38.72

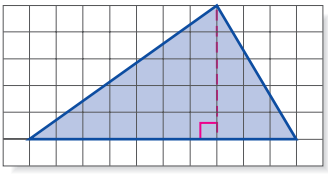
The area of the triangle is 38.72 square meters.

Study Tip

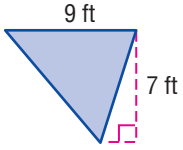
Check for Reasonableness To estimate the area of the triangle in Example 2, round the base to 12 meters and the height to 6 meters. The area is then $\frac{12 \times 6}{2}$ or 36 square meters. Since 38.72 is close to 36, the answer is reasonable.

CHECK Your Progress

a.

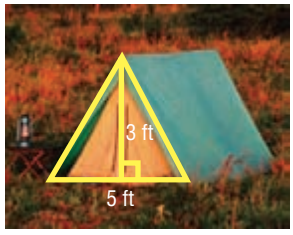


b.



Real-World EXAMPLE

3 **TENTS** **The front of a two-person camping tent has the dimensions shown. How much material was used to make the front of the tent?**



$A = \frac{1}{2}bh$ Area of a triangle

$A = \frac{1}{2}(5)(3)$ Replace b with 5 and h with 3.

$A = \frac{1}{2}(15)$ or 7.5 Multiply.

The front of the tent has an area of 7.5 square feet.

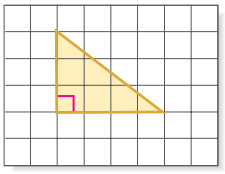
CHECK Your Progress

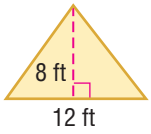
c. **SNACKS** A triangular cracker has a height of 4 centimeters and a base of 5 centimeters. Find the area of the cracker.

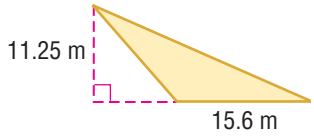
CHECK Your Understanding

Examples 1, 2 (pp. 540–541)

Find the area of each triangle.

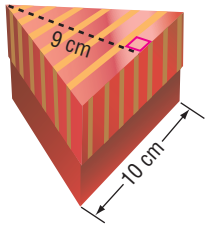
1. 

2. 

3. 

Example 3 (p. 541)

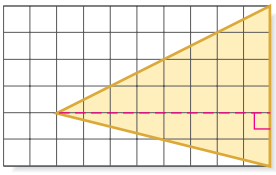
4. **CRAFTS** Consuela made a triangular paper box as shown. What is the area of the top of the box?

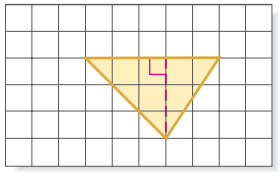


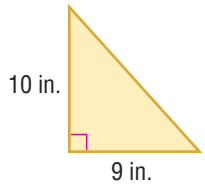
Practice and Problem Solving

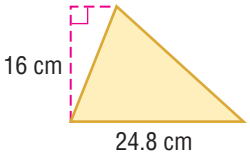
HOMEWORK HELP	
For Exercises	See Examples
5, 6	1
7–12	2
13, 14	3

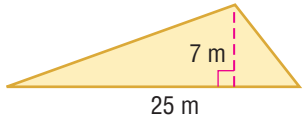
Find the area of each triangle.

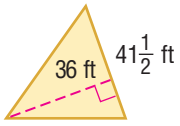
5. 

6. 

7. 

8. 

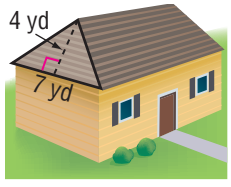
9. 

10. 

11. height: 14 in., base: 35 in.

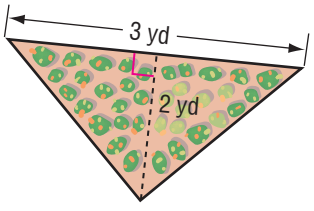
12. height: 27 cm, base: 19 cm

13. **ROOFING** Ansley is going to help his father shingle the roof of their house. What is the area of the triangular portion of one end of the roof to be shingled?



14. **ARCHITECTURE** An architect plans on designing a building on a triangular plot of land. If the base of the triangle is 100.8 feet and the height is 96.3 feet, find the available floor area the architect has to design the building.

15. **FLOWER BEDS** A flower bed in a parking lot is shaped like a triangle as shown. Find the area of the flower bed in square feet. If one bag of topsoil covers 10 square feet, how many bags are needed to cover this flower bed?

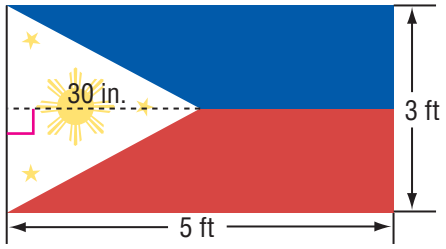


16. **ALGEBRA** The table at the right shows the areas of a triangle where the base of the triangle stays the same but the height changes. Write an algebraic expression that can be used to find the area of a triangle that has a base of 5 units and a height of n units.

Area of Triangles		
Base (units)	Height (units)	Area (units^2)
5	2	5
5	4	10
5	6	15
5	8	20
5	n	

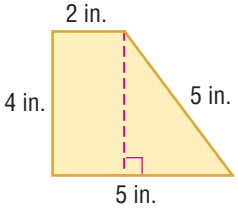
17. **REASONING** Which is smaller, a triangle with an area of 1 square foot or a triangle with an area of 64 square inches?

18. **FLAGS** What is the area of the triangle on the flag of the Philippines at the right?

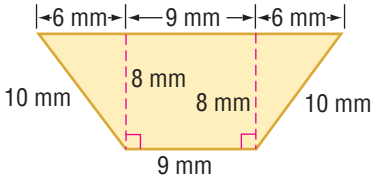


COMPOSITE FIGURES Find the perimeter and area of each figure.

19.



20.

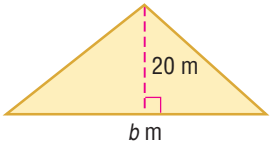


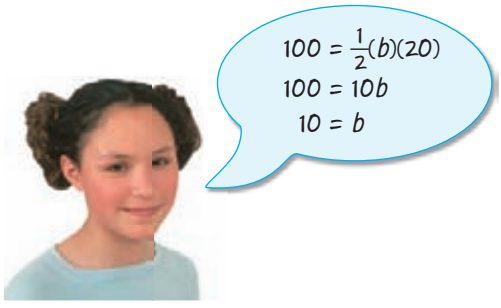
Academic Standards • ISTEP+

Extra Practice, pp. 699, 715

H.O.T. Problems

21. **FIND THE ERROR** Dolores and Demetrius are finding the base of the triangle shown. Its area is 100 square meters. Who is correct? Explain.



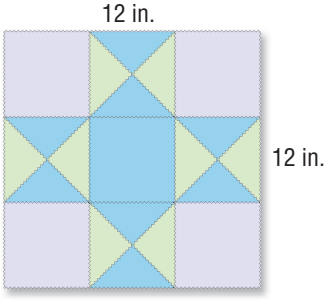


Dolores

Demetrius

CHALLENGE **For Exercises 22–25, use the information below.**

All the triangles and squares in the quilt pattern shown are congruent.



22. Find the measure of the base and height of one of the triangles.

23. Calculate the area of one triangle and then find the area of all the triangles.

24. Calculate the area of one of the smaller squares and then find the area of all of the smaller squares.

25. What is the total area of the figure? Is your answer reasonable?

26. **REASONING** If two triangles have an area of 24 square feet, do they always have the same base and height? Use a model to explain your answer.

27. **WRITING IN MATH** Draw a triangle and label its base and height. Draw another triangle that has the same base, but a height twice that of the first triangle. Find the area of each triangle. Then write a ratio that expresses the area of the first triangle to the area of the second triangle.

ISTEP+ PRACTICE

Reinforcement of 5.3.5

28. The table below shows the areas of a triangle where the height of the triangle stays the same but the base changes.

Areas of Triangles		
Height (units)	Base (units)	Area (square units)
7	2	7
7	3	$10\frac{1}{2}$
7	4	14
7	5	$17\frac{1}{2}$
7	x	?

Which expression can be used to find the area of a triangle that has a height of 7 units and a base of x units?

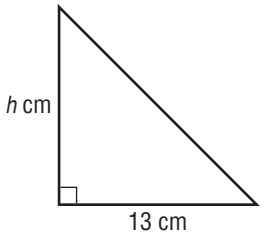
A $7x$

B $\frac{7x}{2}$

C $\frac{7}{2}$

D $\frac{x}{2}$

29. Norma cut a triangle out of construction paper for an art project.



The area of the triangle is 84.5 square centimeters. What is the height of the triangle?

F 6.5 cm

G 13 cm

H 26 cm

J 169 cm

Spiral Review

30. Find the area of a parallelogram with base 15 inches and height 10 inches. (Lesson 10-3)

31. Find the circumference of a circle with a radius of 5 meters. Round to the nearest tenth. (Lesson 10-2)

32. **IDENTIFICATION** Measure the length and width of a student ID card or library card to the nearest eighth inch. Then find the perimeter of the card. (Lessons 1-9 and 10-1)

GET READY for the Next Lesson

33. **PREREQUISITE SKILL** A bookstore arranges its best-seller books in the front window. In how many ways can four best-seller books be arranged in a row? Use the *act it out* strategy. (Lesson 5-3)

CHAPTER 10

Mid-Chapter Quiz

Lessons 10-1 through 10-4

IN Academic Standards
6.3.3, 5.3.5

Find the perimeter of each figure. (Lesson 10-1)

1. 

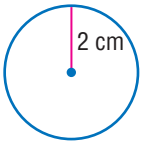
2. 

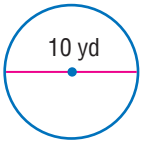
3. **FIELDS** How many feet of fencing is needed to fence a rectangular field 126 feet by 84 feet? (Lesson 10-1)

Find the radius or diameter of each circle with the given dimensions. (Lesson 10-2)

4. $d = 7$ in.
5. $r = 32$ ft
6. $r = 16$ yd
7. $d = 18$ cm

Estimate the circumference of each circle. (Lesson 10-2)

8. 

9. 

10. **POOLS** Find the circumference of a circular pool with a diameter of 3.7 feet. Round to the nearest tenth. (Lesson 10-2)

11. **MULTIPLE CHOICE** Ernesto knows the circumference of a DVD but would like to find the diameter. Which method can Ernesto use to find the diameter of the DVD? (Lesson 10-2)

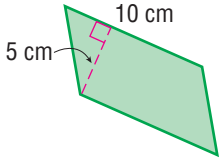
A Multiply the circumference of the DVD by its radius.

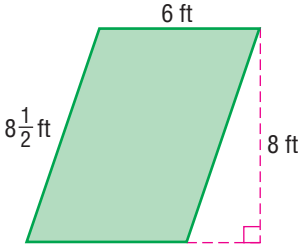
B Divide the circumference of the DVD by π and then divide by 2.

C Divide the circumference of the DVD by π.

D Multiply the circumference of the DVD by 2.

Find the area of each parallelogram. (Lesson 10-3)

12. 

13. 

14. Find the area of a parallelogram with base $5\frac{1}{4}$ feet and height $7\frac{1}{2}$ feet. (Lesson 10-3)

15. **MULTIPLE CHOICE** Which expression can be used to find the area of a triangle that has a height of 9 units and a base of n units? (Lesson 10-4)

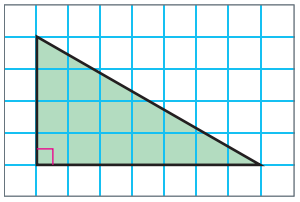
F $9n$

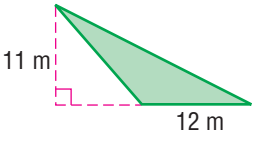
G $\frac{9n}{2}$

H $\frac{9}{2}$

J $\frac{n}{2}$

Find the area of each triangle. (Lesson 10-4)

16. 

17. 

18. **PENNANTS** A pennant for a baseball team is a triangular flag with a base of 12 inches and a height of 30 inches. What is the area of the pennant? (Lesson 10-4)

10-5 Problem-Solving Investigation

MAIN IDEA: Solve problems by making a model.

Academic Standards **P.5.1 Create and use representations to organize, record, and communicate mathematical ideas.** **P.5.2 Select, apply, and translate among mathematical representations to solve problems.** *Also addresses P.1.1.*

P.S.I. TEAM +

e-MAIL: MAKE A MODEL

D.J.: I'm helping set up 7 rows of chairs for a school assembly. There are eight chairs in the first row. Each row after that has two more chairs than the previous row. If I have 100 chairs, can I set up enough rows?

YOUR MISSION: Make a model to find whether D.J. has enough chairs to set up all 7 rows.

Understand	You know that each row has two more chairs than the previous row. The first row has 8 chairs and there are 7 rows. You need to determine if 100 chairs are enough.
Plan	Make a model to see if there are enough chairs.
Solve	Use counters to show the layout of the chairs. Row 1 — 8 chairs Row 2 — 10 chairs Row 3 — 12 chairs Row 4 — 14 chairs Row 5 — 16 chairs Row 6 — 18 chairs Row 7 — 20 chairs Add the number of chairs in each row: $8 + 10 + 12 + 14 + 16 + 18 + 20 = 98$ Since $98 < 100$, there are enough chairs.
Check	The average number of chairs in the first and last row is $\frac{8 + 20}{2} = \frac{28}{2}$ or 14. Since there are 7 rows and $7 \times 14 = 98$, the answer is reasonable. ✔

Analyze The Strategy

1. Tell how making a model helped D.J. solve the problem.
2. **WRITING IN MATH** Write a problem that can be solved by making a model.

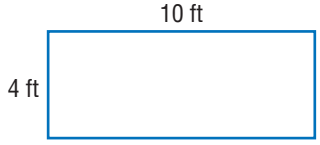
Mixed Problem Solving

Academic Standards • ISTEP+

Extra Practice, pp. 699, 715

Use the *make a model* strategy to solve Exercises 3–5.

3. **GEOMETRY** For a school assignment, Santiago has to give three different possibilities for the dimensions of a rectangle that has a perimeter of 28 feet and an area greater than 30 square feet. One of the models he made is shown below. What are two other possibilities for the dimensions of the rectangle?



4. **DESIGN** A designer wants to arrange 12 square glass bricks into a rectangular shape with the least perimeter possible. How many blocks will be in each row?

5. **PAPER** Timothy took a piece of notebook paper and cut it in half. Then he placed the 2 pieces on top of each other and cut them in half again to have 4 pieces of paper. If he could keep cutting the paper, how many pieces of paper would he have after 6 cuts?

Use any strategy to solve Exercises 6–13. Some strategies are shown below.

PROBLEM-SOLVING STRATEGIES
- Look for a pattern.
- Make a model.
- Draw a diagram.

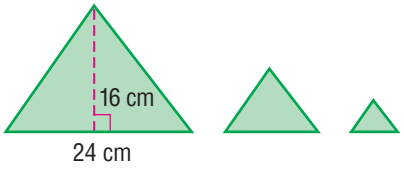
6. **SKATES** Of 50 students surveyed, 22 have a skateboard, and 18 have shoes with wheels. Of those, 6 students have both. How many students have neither a skateboard nor shoes with wheels?

7. **BOOSTERS** In 2008, 25 parents participated in the band booster organization at King Middle School. Participation increased to 40 parents in 2009 and 55 parents in 2010. If the trend continues, about how many parents can be expected to participate in the band booster organization in 2011?

8. **E-MAIL** Meghan sends four friends an e-mail. Each friend then forwards the e-mail to another four friends, and so on. If four friends forward the e-mail to another four friends each hour, how long will it take for 84 friends to receive the e-mail?

9. **ART** Rhonda folded a piece of notebook paper in half twice. Then she punched a hole through all layers. How many holes will there be when she unfolds the paper?

10. **GEOMETRY** The base and height of each triangle are half their length than in the previous triangle. What will be the area of the fourth triangle?

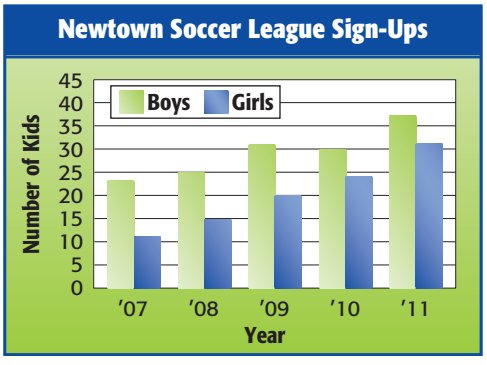


11. **WATER PARKS** What is the total price for two adult and three children one-day passes to a local water park?

	One-day Pass	Two-day Pass
Adults	$40	$45
Child	$30	$35

12. **LOANS** Willow's father purchased a new car. His loan, including interest, is $12,720. How much are his monthly payments if he has 12 payments per year for 5 years?

13. **SOCCER** Refer to the graph. How many more boys signed up for soccer in 2010 than 2008?



10-6 Volume of Rectangular Prisms

MAIN IDEA

Find the volume of rectangular prisms.

IN Academic Standards

Reinforcement of 5.3.6 Develop and use the formulas for the surface area and volume of rectangular prisms using appropriate units for measures.

New Vocabulary

rectangular prism
volume
cubic units

IN Math Online

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- Extra Examples
- Personal Tutor
- Self-Check Quiz

MINI Lab

The figures at the right are *prisms*.

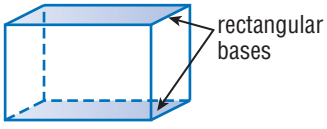
STEP 1 Copy the table below.

Prism	Number of Cubes	Height of Prism	Length of Base	Width of Base	Area of Base
A					
B					
C					
D					
E					

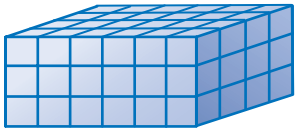
STEP 2 Using centimeter cubes, build five different prisms. For each prism, record the dimensions and the number of cubes used.

1. Examine the rows of the table. What patterns do you notice?
2. **MAKE A CONJECTURE** Describe the relationship between the number of cubes needed and the dimensions of the prism.

A **rectangular prism** is a three-dimensional figure with two parallel bases that are congruent rectangles.



Volume is the amount of space inside a three-dimensional figure. Volume is measured in **cubic units**. Decomposing the prism tells you the number of cubes of a given size it will take to fill the prism.



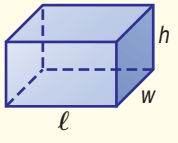
The volume of a rectangular prism is related to its dimensions.

Volume of a Rectangular Prism

Key Concept

Words The volume V of a rectangular prism is the product of its length ℓ, width w, and height h.

Model

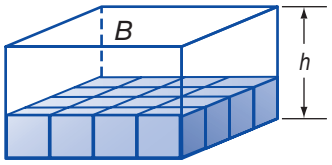


Symbols $V = \ell wh$

Reading Math

Volume Measurement
A volume measurement can be written using abbreviations and an exponent of 3.
For example:
cubic units = units^3
cubic inches = in^3
cubic feet = ft^3
cubic meters = m^3

Another method to decompose a rectangular prism is to find the area of the base (B) and multiply it by the height (h).

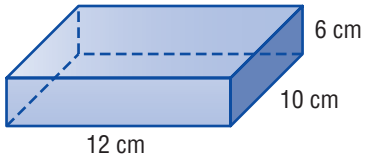


$V = Bh$

- B: area of the base, or the number of cubes needed to cover the base
- h: number of rows of cubes needed to fill the prism

EXAMPLE Find the Volume of a Rectangular Prism

1 **Find the volume of the rectangular prism.**



Estimate

$V \approx 10 \text{ cm} \times 10 \text{ cm} \times 6 \text{ cm}$ or 600 cm^3

In the figure, the length is 12 centimeters, the width is 10 centimeters, and the height is 6 centimeters.

METHOD 1 Use $V = \ell wh$.

$V = \ell wh$	Volume of rectangular prism
$V = 12 \times 10 \times 6$	Replace ℓ with 12, w with 10, and h with 6.
$V = 720$	Multiply.

METHOD 2 Use $V = Bh$.

B, or the area of the base, is 10×12 or 120 square centimeters.

$V = Bh$	Volume of rectangular prism
$V = 120 \times 6$	Replace B with 120 and h with 6.
$V = 720$	Multiply.

The volume is 720 cubic centimeters.

Check for Reasonableness Since we underestimated, the answer should be greater than the estimate. $720 > 600$ ✔

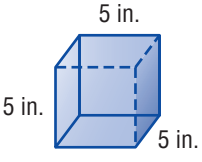
Study Tip

Decomposing Figures
You can think of the volume of the prism as consisting of six congruent slices. Each slice contains the area of the base, 120 cm^2, multiplied by a height of 1 cm.

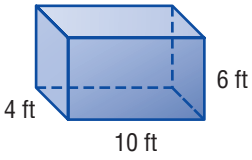
CHOOSE Your Method

Find the volume of each prism.

a.



b.



Real-World Career. . . . . .
How Does a Packaging Manager Use Math?
A packaging manager coordinates and oversees the entire production process of a multi-shift packaging operation.

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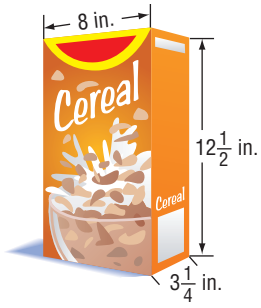
Real-World EXAMPLE

2 **PACKAGING** A cereal box has the dimensions shown. What is the volume of the cereal box?



Estimate $10 \times 3 \times 10 = 300$

Find the volume.

$V = \ell wh$

$V = 8 \times 3\frac{1}{4} \times 12\frac{1}{2}$ Replace ℓ with 8, w with $3\frac{1}{4}$, and h with $12\frac{1}{2}$.

$V = \frac{\overset{1}{\cancel{8}}}{1} \times \frac{13}{\underset{1}{\cancel{4}}} \times \frac{25}{\underset{1}{\cancel{2}}}$ Write as improper fractions. Then divide by the GCFs.

$V = \frac{325}{1}$ or 325 Multiply.

The volume of the cereal box is 325 cubic inches.

Check for Reasonableness $325 \approx 300$ ✔

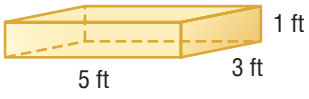
CHECK Your Progress

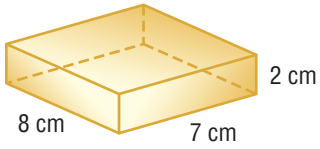
c. **CONTAINERS** A storage container measures 4 inches long, 5 inches high, and $8\frac{1}{2}$ inches wide. Find the volume of the storage container.

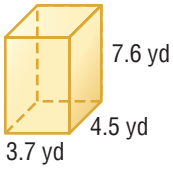
CHECK Your Understanding

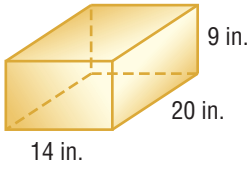
Find the volume of each prism.

Example 1 (p. 549)

1. 

2. 

3. 

4. 

Example 2 (p. 550)

5. **SINKS** A rectangular kitchen sink is 25.25 inches long, 19.75 inches wide, and 10 inches deep. Find the amount of water that can be contained in the sink.

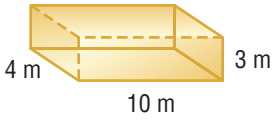
6. **FISHING** A fishing tackle box is 13 inches long, 6 inches wide, and 2.5 inches high. What is the volume of the tackle box?

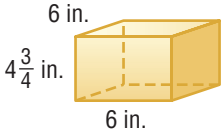
Practice and Problem Solving

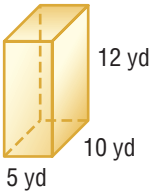
HOMEWORK HELP

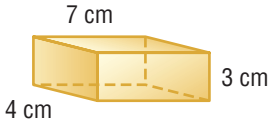
For Exercises	See Examples
7–12	1
13, 14	2

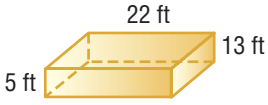
Find the volume of each prism.

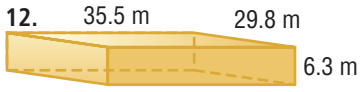
7. 

8. 

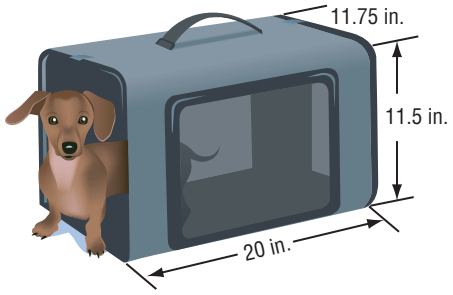
9. 

10. 

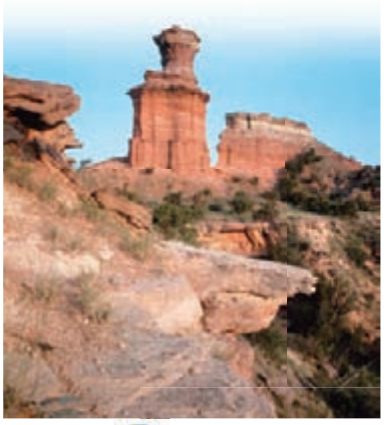
11. 

12. 

13. **PETS** Find the volume of the pet carrier shown at the right.



14. **CANYONS** The Palo Duro Canyon is 120 miles long, as much as 20 miles wide, and has a maximum depth of more than 0.15 mile. What is the approximate volume of this canyon?



Real-World Link Palo Duro Canyon State Park in Canyon, Texas, opened on July 4, 1934, and contains 18,438 acres.

Source: Palo Duro Canyon

15. Find the length of a rectangular prism having a volume of 2,830.5 cubic meters, width of 18.5 meters, and height of 9 meters.

16. What is the width of a rectangular prism with a length of 13 feet, volume of 11,232 cubic feet, and height of 36 feet?

Replace each ● with <, >, or = to make a true sentence.

17. $1 \text{ ft}^3 \bullet 1 \text{ yd}^3$

18. $5 \text{ m}^3 \bullet 5 \text{ yd}^3$

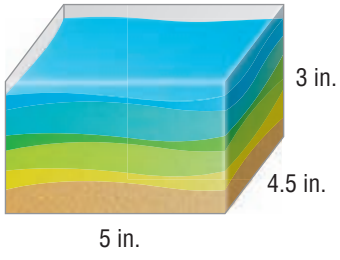
19. $27 \text{ ft}^3 \bullet 1 \text{ yd}^3$

SAND ART **For Exercises 20 and 21, use the following information.**

The glass container shown is filled to a height of 2.25 inches.

20. How much sand is currently in the container?

21. How much more sand could the container hold before it overflows?



22. **NUMBER SENSE** The volume of a cube is 64 cubic feet. What is the height of the cube?

23. **REASONING** Which has the greater volume: a prism with a length of 5 inches, a width of 4 inches, and a height of 10 inches or a prism with a length of 10 inches, a width of 5 inches, and a height of 4 inches? Justify your selection.

ANALYZE TABLES For Exercises 24–26, use the table at the right.

24. What is the approximate volume of the small truck?

25. The Davis family is moving, and they estimate that they will need a truck with about 1,300 cubic feet. Which truck would be best for them to rent?

26. About how many cubic feet greater is the volume of the Mega Moving Truck than the 2-bedroom moving truck?

Inside Dimensions of Moving Trucks

Truck	Length (ft)	Width (ft)	Height (ft)
Van	10	$6\frac{1}{2}$	6
Small Truck	$11\frac{1}{3}$	$7\frac{5}{12}$	$6\frac{3}{4}$
2-Bedroom Moving Truck	$14\frac{1}{12}$	$7\frac{7}{12}$	$7\frac{1}{6}$
3-Bedroom Moving Truck	$20\frac{5}{6}$	$7\frac{1}{2}$	$8\frac{1}{12}$
Mega Moving Truck	$22\frac{1}{4}$	$7\frac{7}{12}$	$8\frac{5}{12}$

27. **ESTIMATION** Jeffrey estimates that the volume of a rectangular prism with a length of 5.8 centimeters, a width of 3 centimeters, and a height of 12.2 centimeters is less than 180 cubic centimeters. Is he correct? Explain.

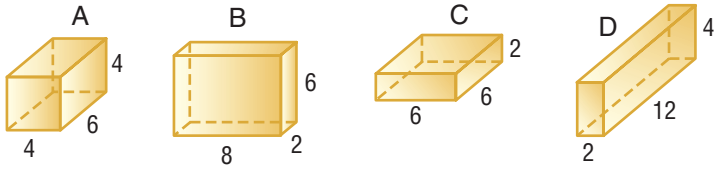
Academic Standards • ISTEP+

Extra Practice, pp. 699, 715

28. **REASONING** The volume of a rectangular prism is 16 cubic feet. The height of the prism is 4 feet and the base of the prism is a square. What is the length of one side of the base?

H.O.T. Problems

29. **Which One Doesn't Belong?** Identify the rectangular prism that does not belong with the other three. Explain your reasoning.

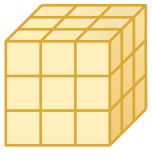


30. **OPEN ENDED** Draw and label a rectangular prism that has a volume between 200 and 400 cubic inches. Then give an example of a real-world object that is this approximate size.

31. **SELECT A TOOL** Basilio is filling his new fish tank with water. The dimensions of the fish tank are 36 inches by 13 inches by 16 inches. Basilio knows that 1 gallon equals 231 cubic inches. Which of the following tools might Basilio use to determine about how many gallons of water he needs to fill the fish tank? Justify your selection(s). Then use the tool(s) to solve the problem.

calculator | centimeter cubes | paper/pencil

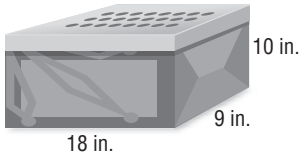
32. **CHALLENGE** Refer to the prism at the right. If all the dimensions of the prism doubled, would the volume double? Explain your reasoning.



33. **WRITING IN MATH** Explain why cubic units are used to measure volume instead of linear units or square units.

ISTEP+ PRACTICE Reinforcement of 5.3.6

34. Justin used the shoebox to create a home for the toad he caught.



Find the volume of the shoebox.

A 222 in^3

B 864 in^3

C 1,620 in^3

D 1,710 in^3

35. A cereal company is creating a new size box in which to package cereal. The box has a width of 27 centimeters, a length of 7 centimeters, and a volume of 6,426 cubic centimeters. Find the height of the cereal box.

F 34 cm

G 38 cm

H 42 cm

J 46 cm

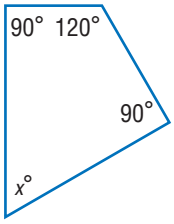
Spiral Review

36. **TOYS** Tiffany is using wooden cube blocks to make rectangular prisms. If she has exactly 8 wooden cube blocks, make a model to find the length, width, and height of two possible rectangular prisms. (Lesson 10-5)

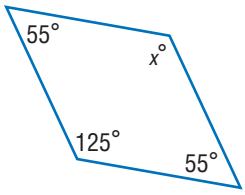
37. What is the area of a triangle with base 52 feet and height 38 feet? (Lesson 10-4)

Find the value of x in each quadrilateral. (Lesson 9-5)

38.



39.



Complete. (Lesson 8-6)

40. ■ cm = 47 mm

41. 3,500 g = ■ kg

42. **CLOTHES** How many outfits can you make with two different colored sweatshirts and four types of jeans? Make an organized list to show the sample space. (Lesson 7-5)

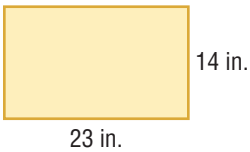
GET READY for the Next Lesson

PREREQUISITE SKILL **Find the area of each rectangle.** (Lesson 1-9)

43.

44.

45.



Explore 10-7

Geometry Lab
Using a Net to Build a Cube

MAIN IDEA

Make a two-dimensional pattern for a cube and use it to build another cube.

IN Academic Standards

Preparation for 7.3.3 Draw two-dimensional patterns (nets) for three-dimensional objects, such as right prisms, pyramids, cylinders and cones.

New Vocabulary

net

IN Math Online

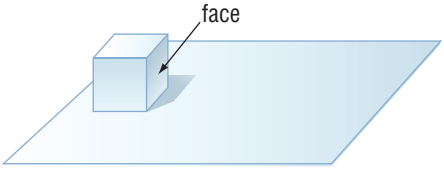
glencoe.com

- Concepts in Motion

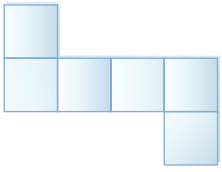
In this lab, you will make a two-dimensional pattern of a cube called a **net** and use it to build the three-dimensional figure.

ACTIVITY

STEP 1 Place the cube on paper as shown. Trace the base of the cube, which is a square.

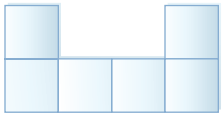


STEP 2 Roll the cube onto another side. Continue tracing each side to make the figure shown. This two-dimensional figure is called a net.



STEP 3 Cut out the net. Then build the cube.

STEP 4 Make a net like the one shown. Cut out the net and try to build a cube.



Analyze the Results

1. Explain whether both nets formed a cube. If not, describe why the net or nets did not cover the cube.
2. Draw three other nets that will form a cube and three other nets that will not form a cube. Describe a pattern in the nets that do form a cube.
3. Measure the edges of the cube in the activity above. Use this measure to find the area of one side of the cube.
4. **MAKE A CONJECTURE** Write an expression for the total area of all the surfaces of a cube with edge length s.
5. Draw a net for a rectangular prism. Explain the difference between this net and the nets that formed a cube.

10-7 Surface Area of Rectangular Prisms

MAIN IDEA

Find the surface areas of rectangular prisms.

IN Academic Standards

Reinforcement of 5.3.6 Develop and use the formulas for the surface area and volume of rectangular prisms using appropriate units for measures.

New Vocabulary

surface area

IN Math Online

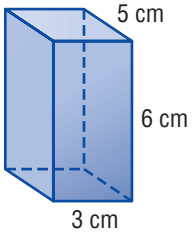
glencoe.com

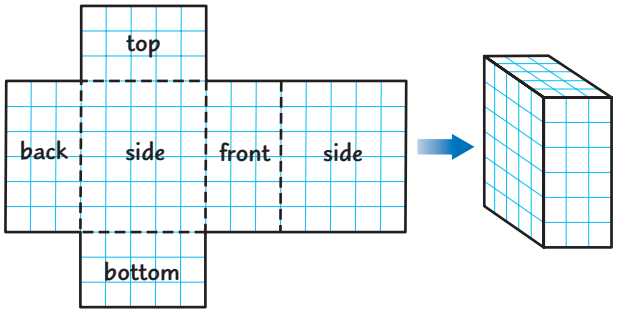
- Extra Examples
- Personal Tutor
- Self-Check Quiz
- Reading in the Content Area

MINI Lab

STEP 1 Draw and cut out a net of the prism.

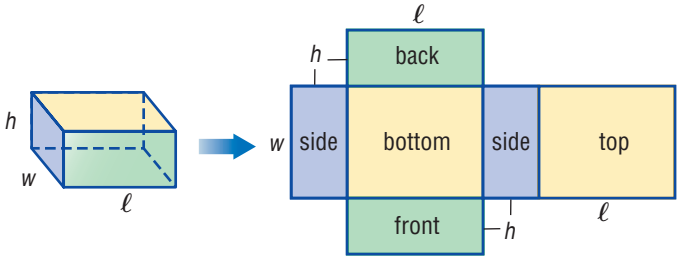
STEP 2 Fold along the dashed lines. Tape the edges.





1. Find the area of each face of the prism.
2. What is the sum of the areas of the faces of the prism?

The sum of the areas of all the faces of a prism is called the **surface area** of the prism.



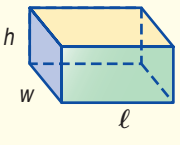
top and bottom	$\ell w + \ell w = 2\ell w$
front and back	$\ell h + \ell h = 2\ell h$
two sides	$wh + wh = 2wh$
sum of the areas	$2\ell w + 2\ell h + 2wh$

Surface Area of a Rectangular Prism

Key Concept

Words The surface area S of a rectangular prism with length ℓ, width w, and height h is the sum of the areas of the faces.

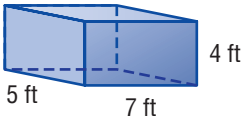
Model



Symbols $S = 2\ell w + 2\ell h + 2wh$

EXAMPLE Find the Surface Area of a Rectangular Prism

1 **Find the surface area of the rectangular prism.**



Find the area of each face.

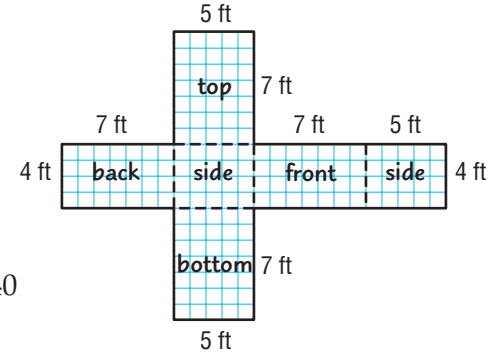
top and bottom:
$2\ell w = 2(7)(5)$ or 70

front and back:
$2\ell h = 2(7)(4)$ or 56

two sides:
$2wh = 2(5)(4)$ or 40

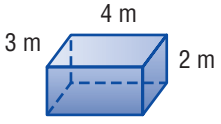
Add to find the surface area.

The surface area is 70 + 56 + 40 or 166 square feet.



CHECK Your Progress

a. Find the surface area of the rectangular prism.



Surface area can be applied to many real-world situations.

Real-World Link
A *geode* is a hollow rock that is lined on the inside with crystal. The largest geode ever found is 30 feet deep and large enough for people to walk through.

Real-World EXAMPLE

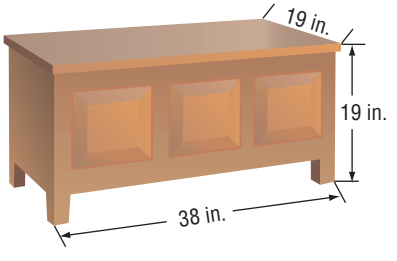
2 **GEOLOGY** **A geode is shaped like a rectangular prism. It is packed in a box that measures 7 inches long, 3 inches wide, and 16 inches tall. What is the surface area of the box?**

$S = 2\ell w + 2\ell h + 2wh$	Surface area of a prism
$S = 2(7)(3) + 2(7)(16) + 2(3)(16)$	$\ell = 7, w = 3, h = 16$
$S = 14(3) + 14(16) + 6(16)$	Multiply.
$S = 42 + 224 + 96$	Multiply.
$S = 362$	Add.

The surface area of the box is 362 square inches.

CHECK Your Progress

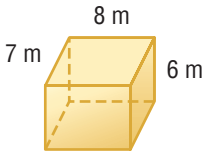
b. **PAINTING** Nadine is going to paint her younger sister's toy chest, including the bottom. What is the approximate surface area that she will paint?

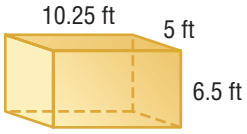


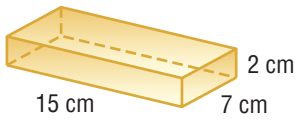
CHECK Your Understanding

Example 1 (p. 556)

Find the surface area of each rectangular prism.

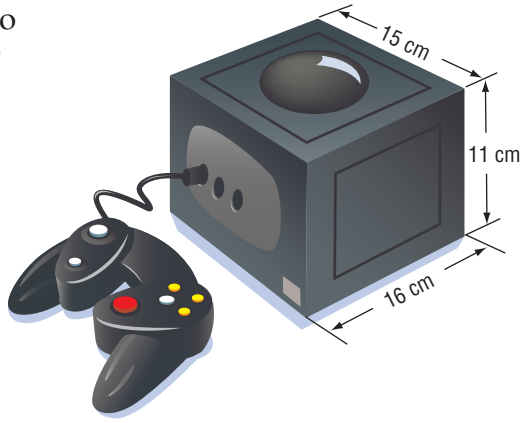
1. 

2. 

3. 

Example 2 (p. 556)

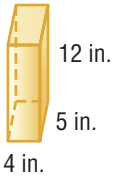
4. **VIDEO GAMES** A game box for video games is shaped like a rectangular prism. What is the surface area of the game box?

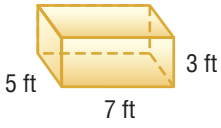


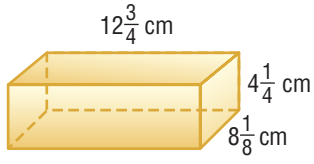
Practice and Problem Solving

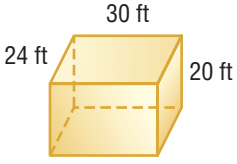
HOMEWORK HELP	
For Exercises	**See Examples**
5–10	1
11, 12	2

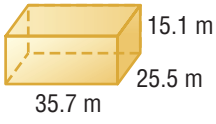
Find the surface area of each rectangular prism.

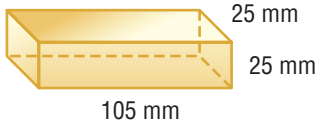
5. 

6. 

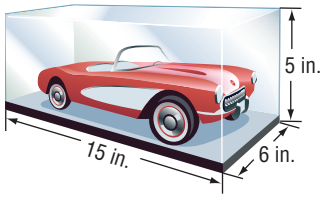
7. 

8. 

9. 

10. 

11. **DISPLAYS** Tomás keeps his diecast car in a glass display case as shown. What is the surface area of the glass?



12. **CAKES** A full sheet cake is typically 18 inches by 24 inches by 2 inches. What is the minimum surface area of a rectangular box that will contain the cake?

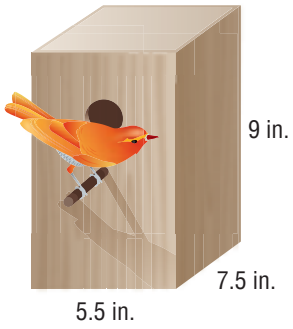
13. **ESTIMATION** Stella estimates that the surface area of a rectangular prism with a length of 13.2 feet, a width of 6 feet, and a height of 8 feet is about 460 square feet. Is her estimate reasonable? Explain your reasoning.

Classify each measure as *length*, *area*, *surface area*, or *volume*. Explain your reasoning. Include an appropriate unit of measure.

14. the amount of water in a lake
15. the amount of land available to build a house
16. the amount of wrapping paper needed to cover a box
17. the number of tiles needed to tile a bathroom floor
18. the amount of tin foil needed to cover a sandwich
19. the amount of cereal that will fit in a box
20. the height of a tree

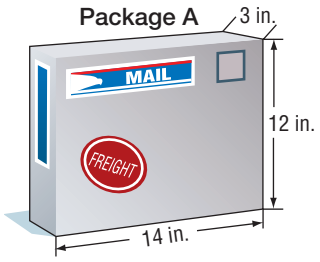
BIRDS For Exercises 21–23, use the following information.

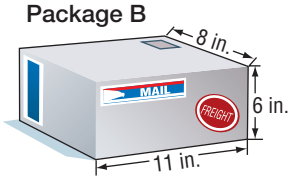
Julia is making a bird nesting box for her backyard.



21. What is the surface area of the nesting box?
22. What is the surface area if the depth is doubled?
23. What is the surface area if the depth is half as great?

24. **SHIPPING** Find the surface area of each shipping package. Which package has the greater surface area? Does the same package have a greater volume? Explain.





Academic Standards • ISTEP+

Extra Practice, pp. 700, 715

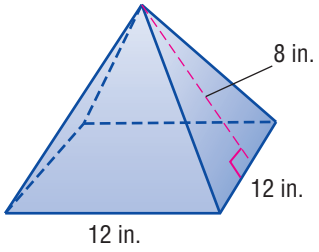
H.O.T. Problems

25. **OPEN ENDED** Draw and label a rectangular prism that has a surface area of 208 square feet.

26. **REASONING** Determine whether the following statement is *sometimes*, *always*, or *never* true. Explain your reasoning.

If all the dimensions of a cube are doubled, the surface area is four times greater.

CHALLENGE For Exercises 27 and 28, use the figure shown. All of the triangular faces are congruent.

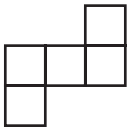


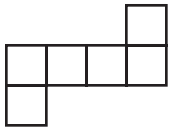
27. What is the area of one of the triangular faces? the square face?
28. Use what you know about finding the surface area of a rectangular prism to find the surface area of the square pyramid.

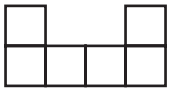
29. **WRITING IN MATH** Write a problem about a real-world situation in which you would need to find the surface area of a rectangular prism.

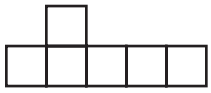
ISTEP+ PRACTICE Reinforcement of 5.3.6

30. Which net can be used to make and find the surface area of a cube?

A 

B 

C 

D 

31. Horacio is going to paint a shoebox to use for storage of his trading cards. The shoebox is 23 inches long, 10 inches wide, and 8 inches high. Find the surface area of the shoebox.

F 246 in^2

G 828 in^2

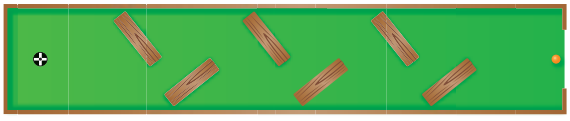
H 988 in^2

J 1,840 in^2

Spiral Review

32. Find the volume of a rectangular prism with sides measuring 5 feet, 8 feet, and 12 feet. (Lesson 10-6)

33. **MINIATURE GOLF** Find the perimeter and area of the miniature golf hole shown. (Lessons 1-9 and 10-6)



34. **MONEY** Measure the length of a dollar bill to the nearest sixteenth inch. (Lesson 8-1)

35. **PHONES** How many ways can A.J. call three of his friends? Make an organized list to show the sample space. (Lesson 7-5)

Write each decimal as a percent. (Lesson 7-3)

36. 0.44 37. 5.35 38. 0.6 39. 2.1

Problem Solving in Industrial Education

Real-World Unit Project

A New Zoo It's time to complete your project. Use the data you have collected about your selected zoo animals to create a set of drawings or blueprints for your zoo. Be sure to include all dimensions, areas, surface areas, and volumes of each section of your zoo as well as feeding schedules and temperature conditions.

IN Math Online Unit Project at glencoe.com

Extend 10-7

Measurement Lab
Selecting Formulas and Units

MAIN IDEA

Select appropriate units, tools, and formulas to measure objects.

IN Academic Standards

6.3.4 Recognize that real-world measurements are approximations. Identify appropriate instruments and units for a given measurement situation, taking into account the precision of the measurement desired.

Recall from Lesson 8-8 that an *attribute* is a characteristic of an object. Some attributes, like length and width, can be measured directly on the object. These measures are called *direct measures*. Others, like perimeter, circumference, area, and volume, can be calculated from direct measures. These are *calculated measures*.

ACTIVITY

STEP 1 Copy the table below.

Object	Attribute	Formula Needed	Direct Measure(s)	Calculated Measure(s)
shoebox				
chalkboard				
desktop				
cereal box				
clock face				
bulletin board				
basketball				

STEP 2 Choose an attribute for each object that involves a calculated measure. Then determine what attributes of the object you must measure directly in order to calculate this measure. Record this information in the table.

STEP 3 Indicate what formula you need to use in order to calculate each measure.

STEP 4 Select a measuring tool from among those provided by your teacher, and find the direct measure(s) for each object using the smallest unit on your measuring tool. Record each measure in the table. Be sure to include appropriate units.

Analyze the Results

1. Which object did you find most difficult to measure directly? How did you solve this problem?

2. WRITING IN MATH Write a real-world problem that could be solved using one of the objects and the measure you calculated.

CHAPTER 10

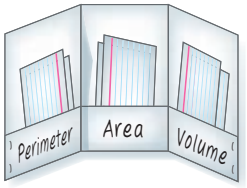
Study Guide and Review

IN Math Online glencoe.com
- STUDY TO GO
- Vocabulary Review

FOLDABLES Study Organizer

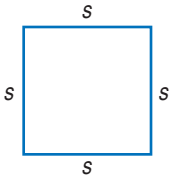
GET READY to Study

Be sure the following Big Ideas are noted in your Foldable.

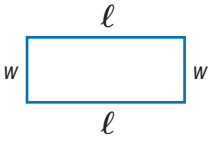


BIG Ideas

Perimeter (Lesson 10-1)

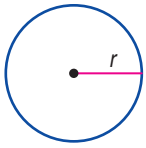


$P = 4s$



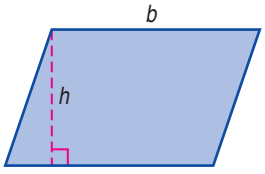
$P = 2\ell + 2w$

Circles and Circumference (Lesson 10-2)

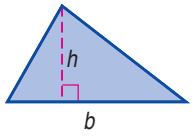


$d = 2r$
$C = \pi d$ or $C = 2\pi r$

Area (Lessons 10-3 and 10-4)

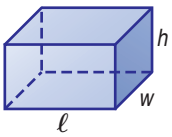


$A = bh$



$A = \frac{bh}{2}$ or $A = \frac{1}{2}bh$

Volume and Surface Area (Lessons 10-6 and 10-7)



$V = \ell wh$
$S = 2\ell w + 2\ell h + 2wh$

Key Vocabulary

- base (p. 534)
- center (p. 528)
- chord (p. 528)
- circle (p. 528)
- circumference (p. 528)
- diameter (p. 528)
- height (p. 534)
- net (p. 554)
- perimeter (p. 522)
- radius (p. 528)
- rectangular prism (p. 548)
- surface area (p. 555)
- volume (p. 548)

Vocabulary Check

Choose the correct term to complete each sentence.

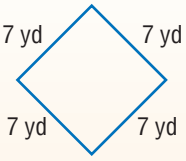
1. The amount of space that a three-dimensional figure contains is called its (area, volume).
2. The shortest distance from the base to the opposite side of a parallelogram is called the (height, center).
3. The distance around any closed figure is called its (surface area, perimeter).
4. In estimating the circumference of a circle, round the value of π to (3, 4).
5. Cubic units are used when calculating (surface area, volume).
6. The distance around a circle is called the (diameter, circumference).
7. The longest chord of a circle is the (radius, diameter).

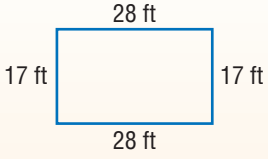
Lesson-by-Lesson Review

10-1 Perimeter (pp. 522–526)

5.3.5

Find the perimeter of each figure.

8. 

9. 

10. **WALLPAPER** How many feet of wallpaper border are needed for a bedroom wall that is 11 feet long and 9 feet wide?

Example 1 **Find the perimeter of the rectangle.**

$P = 2\ell + 2w$
$P = 2(23) + 2(9)$
$P = 46 + 18$
$P = 64$ in.
The perimeter is 64 inches.

10-2 Circles and Circumference (pp. 528–533)

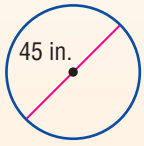
6.3.3

Find the radius or diameter of each circle with the given dimensions.

11. $d = 58$ cm
12. $r = 27$ in.
13. $r = 9$ ft
14. $d = 32$ yd

Estimate the circumference of each circle.

15. 

16. 

Find the circumference of each circle. Round to the nearest tenth.

17. 

18. 

19. **RIDES** The plans for a carousel call for a circular floor with a diameter of 40 feet. Find the circumference of the floor.

Example 2 **Find the radius of a circle with diameter 68 yards.**

The radius of a circle is half its diameter. So, the radius of a circle with a diameter of 68 yards is $\frac{1}{2}$ of 68 yards, or 34 yards.

Example 3 **Estimate the circumference of a circle with radius 8 feet.**

The circumference of a circle is π times twice its radius. The circumference is about $3 \times 2 \times 8$, or 48 feet.

Example 4 **Find the circumference of the circle at the right. Round to the nearest tenth.**

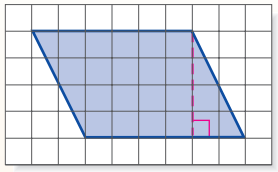
The circumference of a circle is π times its diameter. The circumference is $\pi \times 5$ centimeters, or 15.7 centimeters.

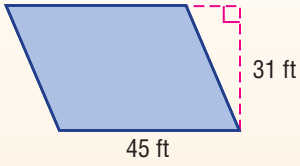
Mixed Problem Solving
For mixed problem-solving practice, see page 715.

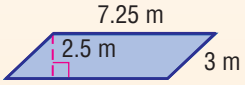
10-3 Area of Parallelograms (pp. 534–538)

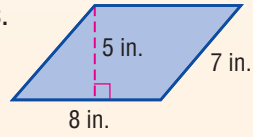
5.3.5

Find the area of each parallelogram.

20. 

21. 

22. 

23. 

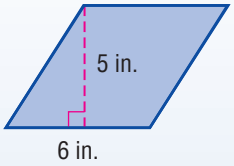
24. **DECKS** Find the area of a deck if it is a parallelogram with base $8\frac{1}{4}$ feet and height 6 feet.

Example 5 Find the area of the parallelogram.

$A = bh$

$A = 6 \cdot 5$

$A = 30 \text{ in}^2$



Example 6 Find the area of a parallelogram with base 4.3 meters and height 11.2 meters.

$A = bh$

$A = 4.3 \cdot 11.2$

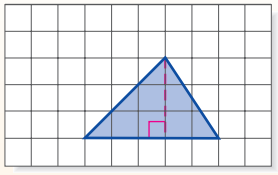
$A = 48.16$

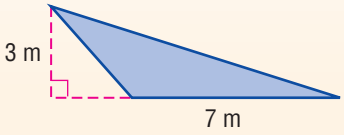
The area is 48.16 square meters.

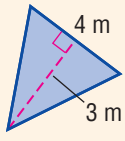
10-4 Area of Triangles (pp. 540–544)

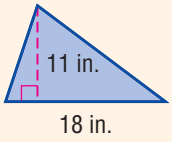
5.3.5

Find the area of each triangle.

25. 

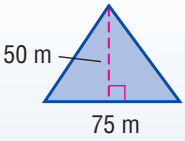
26. 

27. 

28. 

29. **FLAGS** How much material is needed to make a triangular flag with base $2\frac{1}{4}$ feet and height $8\frac{1}{2}$ feet?

Example 7 Find the area of the triangle.



$A = \frac{1}{2}bh$

$A = \frac{1}{2}(75 \cdot 50)$

$A = 1{,}875 \text{ m}^2$

Example 8 Find the area of a triangular garden with base 8 feet and height 7 feet.

$A = \frac{1}{2}bh$

$A = \frac{1}{2}(8)(7)$

$A = \frac{1}{2}(56)$

$A = 28$

The area is 28 square feet.

10-5 PSI: Make a Model (pp. 546–547)

P.5.1, P.5.2

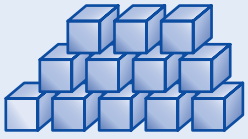
Solve. Use the *make a model* strategy.

30. **CANS** A grocer is stacking cans of tomato soup into a pyramid-shaped display. The bottom layer has 8 cans. There is one less can in each layer and there are 6 layers. How many cans are in the display?

31. **BRICKS** A brick layer wants to arrange 16 bricks into a rectangular shape with the greatest perimeter possible. How many bricks will be in each row?

Example 9 **A cheerleading squad formed a pyramid. There were 5 cheerleaders on the bottom and one less cheerleader in each row. How many rows were in the pyramid, if there are 12 cheerleaders?**

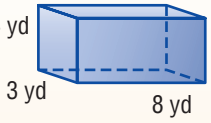
Using 12 cubes, place 5 cubes on the bottom and one less cube in each layer as shown. There are 3 rows.

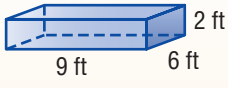


10-6 Volume of Rectangular Prisms (pp. 548–553)

5.3.6

Find the volume of each figure.

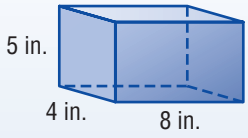
32. 

33. 

34. **BUILDINGS** What is the volume of an office building with length 168 yards, width 115 yards, and height 96 yards?

Example 10 **Find the volume of the figure.**

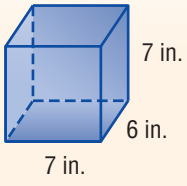
$V = \ell wh$
$V = 8 \times 4 \times 5$
$V = 160$
The volume is 160 cubic inches.

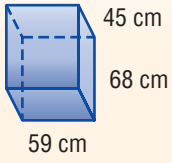


10-7 Surface Area of Rectangular Prisms (pp. 555–559)

5.3.6

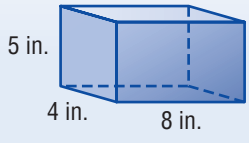
Find the surface area of each rectangular prism.

35. 

36. 

37. **TISSUE BOXES** How much cardboard covers the outside of a tissue box if the dimensions of the box are to be 4 inches by 3 inches by 5 inches?

Example 11 **Find the surface area of the rectangular prism.**



top and bottom: $2(8 \times 4)$ or 64
front and back: $2(8 \times 5)$ or 80
two sides: $2(4 \times 5)$ or 40
The surface area is $64 + 80 + 40$ or 184 square feet.

CHAPTER 10

Practice Test

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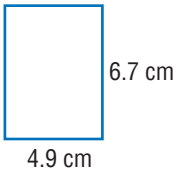
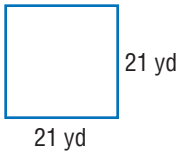
• Chapter Test

Find the perimeter of each figure.

1. 

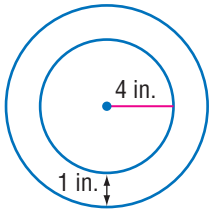
2. 

Find the radius or diameter of each circle with the given dimensions.

3. $r = 9$ in.

4. $d = 46$ mm

5. **MULTIPLE CHOICE** The drawing shows two circles that have the same center.



Which expression can be used to find the approximate circumference of the outer circle in inches?

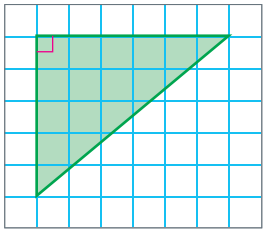
A $\pi(4 + 1)$

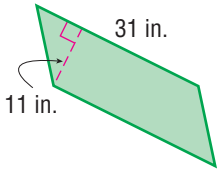
B $\frac{1}{2}(4 + 1)$

C $2\pi(4 + 1)$

D $2(4 + 1)$

Find the area of each parallelogram or triangle.

6. 

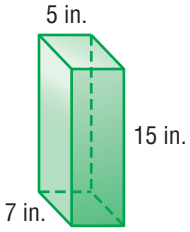
7. 

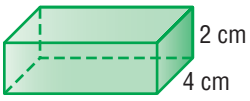
8. **REASONING** Which has the greater area, a triangle with a base of 8 meters and a height of 12 meters, or a triangle with a base of 4 meters and a height of 16 meters? Justify your response.

9. **GARDENING** A triangular garden has a base of 7 meters and a height of 6 meters. If one bag of fertilizer covers 25 square meters, how many bags of fertilizer are needed to fertilize the garden?

10. **GEOMETRY** A rectangular prism is made using exactly 12 cubes. Find a possible length, width, and height of the prism. Use the *make a model* strategy.

Find the volume of each figure.

11. 

12. 

13. **POOLS** A rectangular pool is 21 feet long by 18 feet wide. Find the number of cubic feet of water required to fill the pool so that the water is 9 feet deep.

14. **MULTIPLE CHOICE** Which expression gives the surface area of a rectangular prism with length 5 units, width 8 units, and height 3 units?

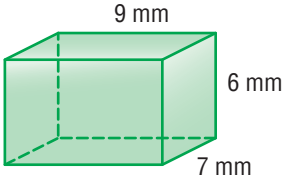
F $(2)(5^2) + (2)(8^2) + (2)(3^2)$

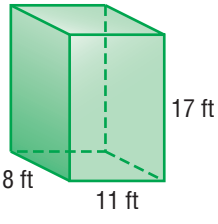
G $2(5)(8) + 2(5)(3) + 2(8)(3)$

H $2(5)(8)(3)$

J $(2)(5)(8 + 3)$

Find the surface area of each rectangular prism.

15. 

16. 

CHAPTER 10

ISTEP+ Practice

Cumulative, Chapters 1–10

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• Test Practice

PART 1 Multiple Choice

Read each question. Then fill in the correct answer on the answer sheet provided by your teacher or on a sheet of paper.

1. The table below shows the areas of a triangle where the height of the triangle stays the same, but the base changes.

Area of Triangles		
Height (units)	Base (units)	Area (square units)
4	3	6
4	4	8
4	5	10
4	6	12
4	n	■

Which expression can be used to find the area of a triangle that has a height of 4 units and a base of n units?

A $\frac{n}{4}$ **C** $\frac{4}{2n}$

B $\frac{4n}{2}$ **D** $4n$

TEST-TAKING TIP

Question 1 Many standardized tests list any geometry formulas you will need to solve problems. However, it is a good idea to familiarize yourself with the formulas before the test.

2. Annalese is making necklaces for her friends. She has determined that it takes her about 28 minutes to make each necklace. About how long will it take Annalese to make 7 necklaces?

F 1 h 96 min

G 2 h 40 min

H 3 h 16 min

J 4 h

3. Julie has a circular garden in her front yard with a diameter of 8 feet. How does the diameter d compare to the circumference C of the garden?

A $d \approx \frac{1}{3}C$ **C** $d \approx 2C$

B $d \approx \frac{1}{2}C$ **D** $d \approx 3C$

4. An angle of an isosceles triangle measures 40°. The other two angles in the triangle are congruent. Which method can be used to find the measure of each congruent angle?

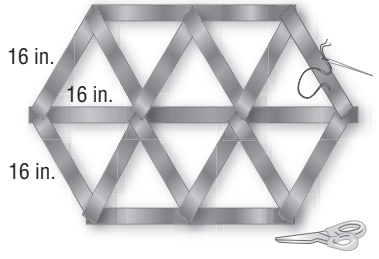
F Multiply 40 by 2. Then add 180.

G Subtract 40 from 180. Then divide by 2.

H Add 40 to 180. Then divide by 3.

J Divide 50 by 2. Then subtract from 180.

5. Mrs. Bixler designed a quilt by outlining equilateral triangles with ribbon as shown below. How much ribbon did Mrs. Bixler use to complete her quilt?



A 125 in. **C** 304 in.

B 264 in. **D** 320 in.

6. In the spreadsheet below, a formula applied to the values in columns A and B results in the values in column C. What is the formula?

F $C = A - B$

G $C = A - 2B$

H $C = A + B$

J $C = A + 2B$

	A	B	C
1	4	0	4
2	5	1	3
3	6	2	2
4	7	3	1

7. In Mrs. Baumgartner's classroom library, the ratio of fiction to non-fiction books is 3 to 4. Which of the following shows possible numbers of fiction to non-fiction books in Mrs. Baumgartner's library?

A 132 fiction, 172 non-fiction

B 165 fiction, 228 non-fiction

C 168 fiction, 224 non-fiction

D 186 fiction, 242 non-fiction

8. The owner of an ice skating rink recorded the number of paying customers for one week. The table below shows the results. About how many customers paid during the week?

Day	Customers
Monday	42
Tuesday	38
Wednesday	56
Thursday	62
Friday	81
Saturday	112
Sunday	143

F 600

G 580

H 550

J 500

9. Jermil left home at 2:55 P.M. for field hockey practice. He returned home from practice at 5:05 P.M. About how long was Jermil gone?

A 2 h **C** 4 h

B 3 h **D** 5 h

PART 2 Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

10. The side lengths and perimeters of regular polygons are shown in the table below. Which geometric figure is represented by the information in the table?

Side Length (inches)	Perimeter (inches)
3	12
5	20
8	32
10	40

11. Mario used a square baking pan to make a cake. The length of each side of the pan was 16 inches. Find the area of the pan in square inches.

PART 3 Extended Response

Record your answers on the answer sheet provided by your teacher or on a sheet of paper. Show your work.

12. Leora is gift wrapping a box that measures 15 inches long, 9 inches wide, and 3 inches high.

a. Find the surface area and the volume of the box.

b. What is the effect on the surface area and the volume if each dimension is doubled?

c. What is the effect if only one dimension is doubled? Does it matter which dimension is doubled? Explain.

NEED EXTRA HELP?												
If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12
Go to Lesson...	10-4	8-7	10-2	9-4	9-4	6-7	6-1	1-1	8-7	10-1	1-9	10-6
IN Academic Standards	5.3.5	6.3.4	6.3.3	6.3.2	6.3.2	6.2.5	6.1.7	P.1.1	6.3.4	5.3.5	6.2.2	6.3.5