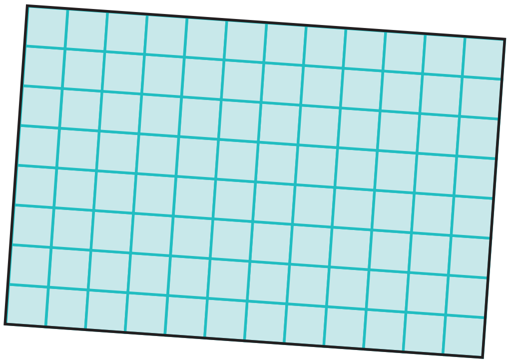
Chapter

10 Area and Perimeter

Dear Student,

In this chapter, "Area and Perimeter," you will measure flat, or two-dimensional, figures in two ways: by finding their perimeters and by finding their areas. Perimeter is the measurement of length around the outside of a figure, and area is the measurement of the space inside.

You already know how to find the area of a rectangle because you have used arrays of tiles to think about multiplication.



You will use this knowledge to help you figure out area formulas for parallelograms, triangles, and trapezoids. You will also figure out formulas for the perimeters of various figures.

Mathematically yours,

The authors of ***Think Math!***

THE WORLD ALMANAC FOR KIDS

Up, Up, and Away!

Have you ever flown a kite? Flying kites is a popular pastime in many places around the world. Flat kites come in the familiar diamond shape, but they also come in squares, triangles, and in shapes like a fish or dragon. There are flat kites, box kites, train kites, and many other types of kites.

FACT·ACTIVITY 1

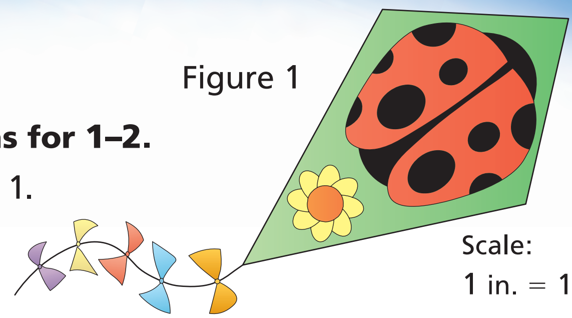


Figure 1

Scale:
1 in. = 1 ft

Use Figure 1 to answer questions for 1–2.

1. Measure the perimeter of Figure 1. What is the perimeter?
2. Based on the scale of Figure 1, what is the actual perimeter of the kite?
3. What is the perimeter of the square kite? Explain how you found your answer.
4. On a separate sheet of paper, draw a kite in the shape of a parallelogram. Measure the length of its sides to the nearest inch. Find its perimeter. If you built this kite using a scale of 1 in. = 1 ft, what would its perimeter actually be?

70 cm

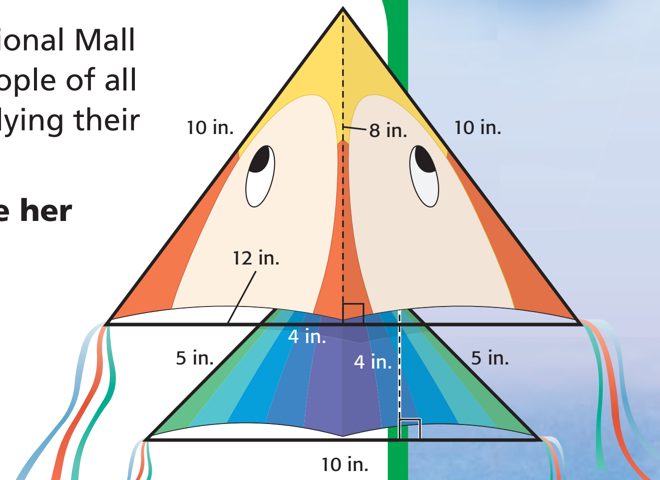
Square Kite

FACT · ACTIVITY 2

In late March and early April, the sky on the National Mall in Washington D.C. is filled with colorful kites. People of all ages participate in the Smithsonian Kite Festival flying their handmade kites.

Vanessa has sketched a design for a kite. Use her design for Problems 1–4.

1. Identify the figures that make up the kite.
2. Find the perimeter and area of each figure you named in Problem 1.
3. About how much crepe paper does Vanessa need to make her kite?
4. Using your estimate from Problem 3, draw a kite design that has the same area but a different shape.



Vanessa's Kite Design

CHAPTER PROJECT

- Design a kite that is a figure such as a triangle, rhombus, or a square.
- Make a sketch of your kite on grid paper. Decide on a scale for your drawing. Then, estimate the perimeter and area of your kite.
- Now, you are going to make a kite based on your drawing and the area of your kite. Gather all the materials you will need.
- Tape or tie a frame together. Measure and cut out your sail. Attach it to the frame with tape. Attach one end of the flying line to the frame and the other end to the reel wound with flying line. Make a tail and decorate your kite.

Kite Materials

- Frame (wooden sticks)
- Sail (newspaper, plastic, crepe paper, etc.)
- Flying line
- Tail (optional, makes it steadier against strong wind)
- Reel (cardboard, glue sticks, etc.)

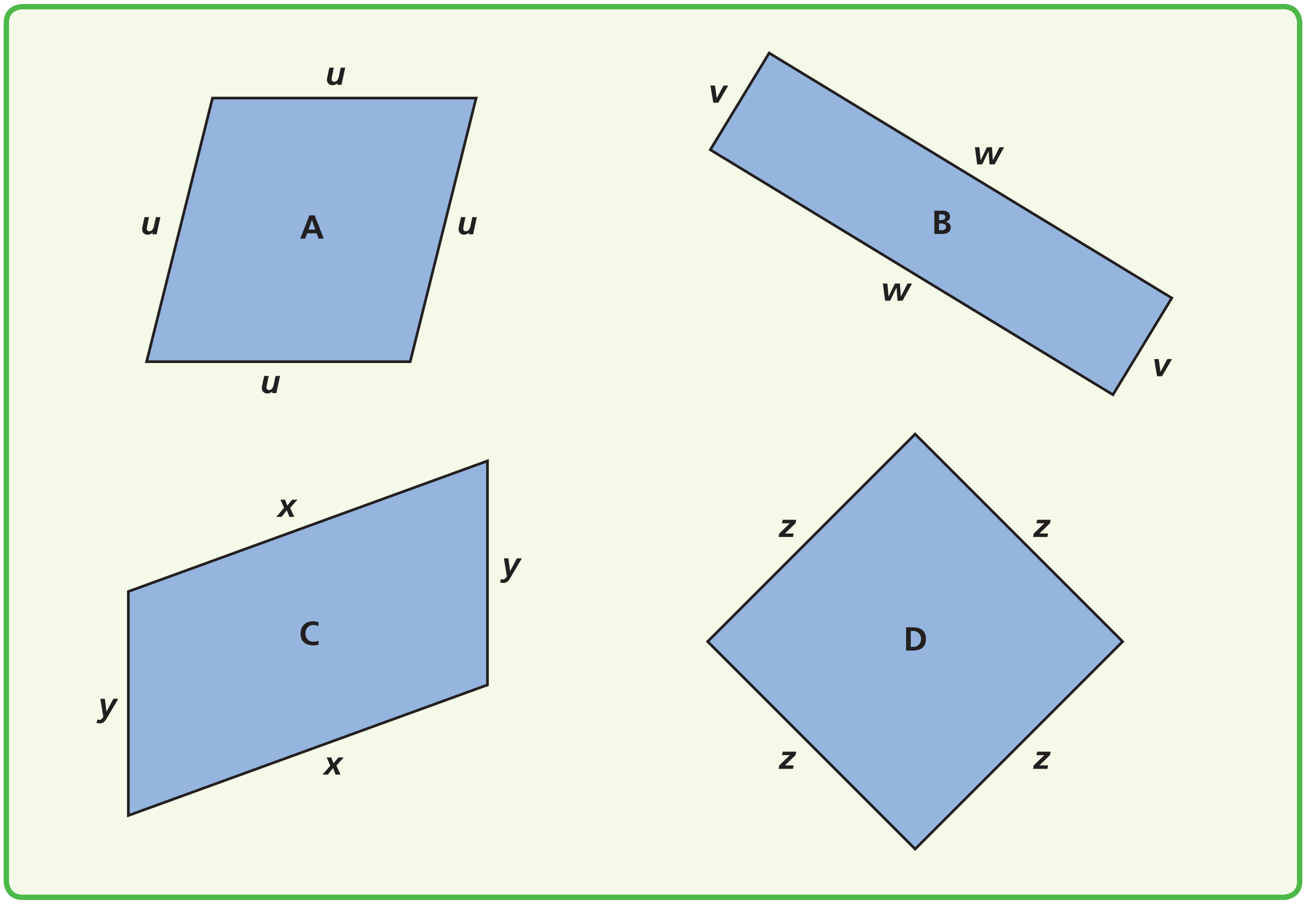
ALMANAC Fact

The area of the largest kite ever made was 630 square meters.

Chapter 10
Lesson 2

EXPLORE
Perimeter of Parallelograms

The sides of these parallelograms are labeled to show each length and which sides are equal in length.



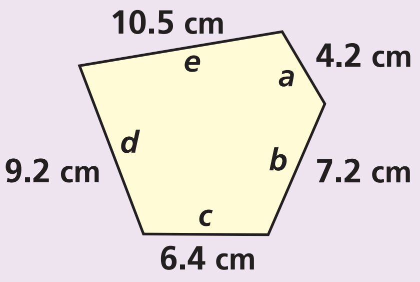
1. Find the perimeter of each figure.

2. What can you say about the equality of side lengths in any parallelogram?

3. How can you find the perimeter of any parallelogram?

REVIEW MODEL
Finding Perimeter

Perimeter is the distance around a figure. You can find the perimeter of any polygon by adding the lengths of its sides.



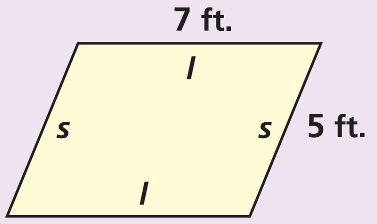
$$P = a + b + c + d + e$$

$$4.2 + 7.2 + 6.4 + 9.2 + 10.5 = 37.5$$

So, the perimeter is 37.5 centimeters.

You can use these formulas to find the perimeters of parallelograms.

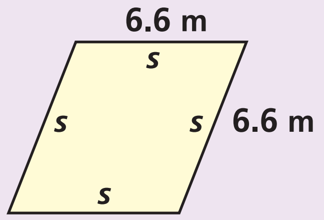
Since a parallelogram has two pairs of congruent sides, you can use one of these formulas to find its perimeter.



$\boldsymbol{P = 2 \times (l + s)}$	$\boldsymbol{P = (2 \times l) + (2 \times s)}$
$P = 2 \times (7 + 5)$	$P = (2 \times 7) + (2 \times 5)$
$P = 2 \times 12$	$P = 14 + 10$
$P = 24$	$P = 24$

So, the perimeter is 24 feet.

If all the sides of a parallelogram are congruent, you can use this formula to find its perimeter.



$\boldsymbol{P = 4 \times s}$

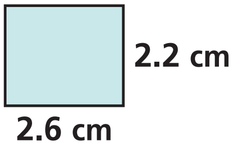
$P = 4 \times 6.6$

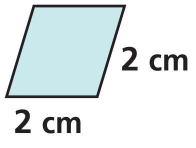
$P = 26.4$

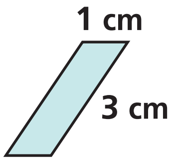
So, the perimeter is 26.4 meters.

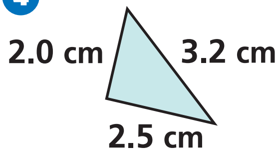
Check for Understanding

Find the perimeter of each polygon.

1. 

2. 

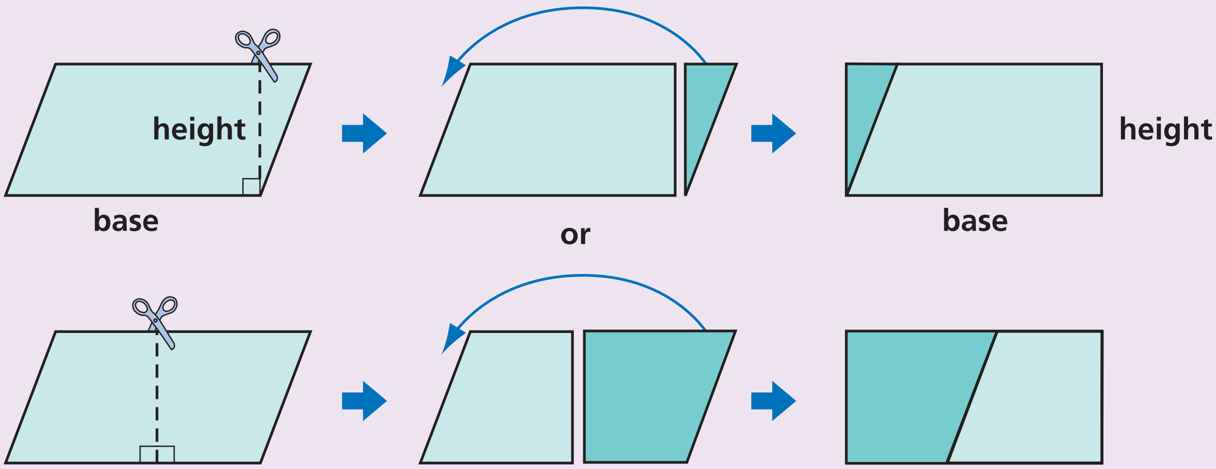
3. 

4. 

REVIEW MODEL
Finding Area of a Parallelogram

Area is the amount of space inside a two-dimensional figure. You measure area in square units.

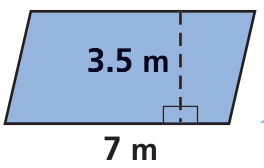
These diagrams show how you can use what you know about the area of a rectangle to find the area of a parallelogram.



Area of rectangle = *base* × *height*
$A = b \times h$

Area of parallelogram = *base* × *height*
$A = b \times h$

Example 1 Find the area.



Sometimes you can use given dimensions to find area.

Area = *base* × *height*
7 m × 3.5 m
24.5 sq m

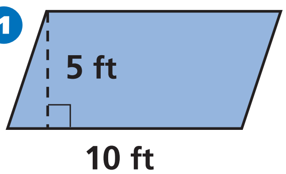
Example 2 Find the area.

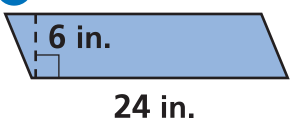
Sometimes you need to first measure to find the lengths of the base and the height.
b = 3 cm
h = 1 cm
Then you can find the area.

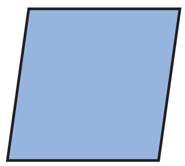
Area = *base* × *height*
3 cm × 1 cm
3 sq cm

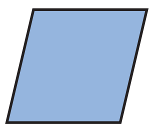
Check for Understanding

Find the area of each parallelogram. For 3 and 4, use a cm ruler to first find the base and height.

1. 

2. 

3. 

4. 

Chapter 10
Lesson 5

EXPLORE
Area of Triangles

You will need scissors, tape, and an inch ruler.

1. Cut out the two triangles from Activity Master 92. Save the trapezoids for later.

2. Compare the two triangles. Do you think they are congruent? Why or why not?

3. Find at least two different ways to form a parallelogram with the two triangles. Choose one and tape the triangles together to make that parallelogram.

4. Use an inch ruler to measure the base and height of your parallelogram to the nearest half-inch. What is the area of the parallelogram?

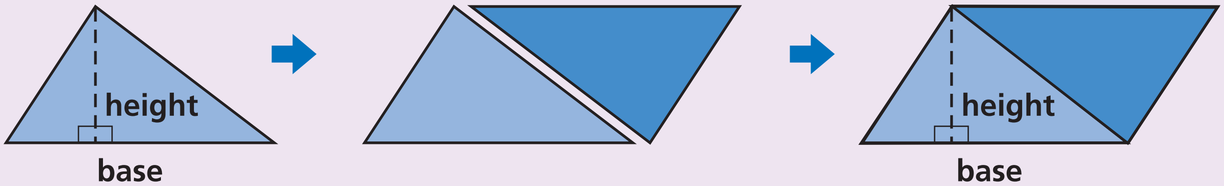
5. Use the area of the parallelogram to find the area of each triangle.
   - **How does the area of the triangle compare to the area of the parallelogram?**
   - **How do the lengths of the sides of the triangle compare to the length of the base of the parallelogram?**
   - **What part of the triangle has the same height as the height of the parallelogram?**

Chapter 10

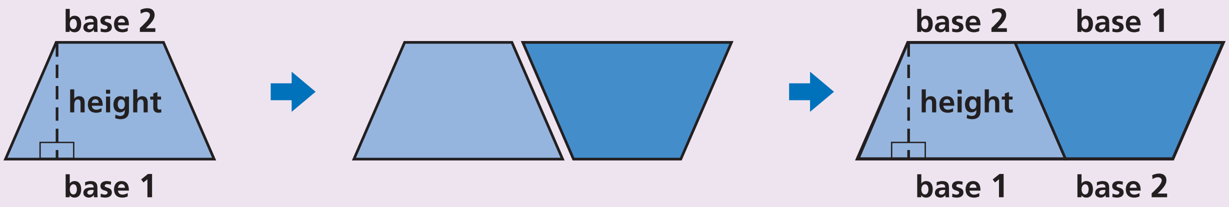
Lesson 5

REVIEW MODEL
Finding Areas of Triangles and Trapezoids

These diagrams show how you can use what you know about finding the area of a parallelogram to find the area of a triangle or the area of a trapezoid.

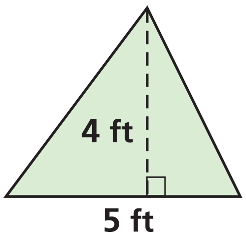


Area of triangle $= \frac{1}{2} \times$ area of parallelogram $= \frac{1}{2} \times base \times height = \frac{1}{2} \times b \times h$



Area of trapezoid $= \frac{1}{2} \times$ area of parallelogram $= \frac{1}{2} \times (b_1 + b_2) \times h$

Example 1 Find the area.

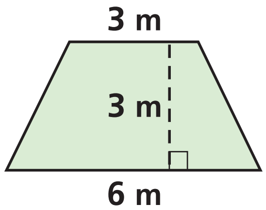


Area $= \frac{1}{2} \times b \times h = \frac{1}{2} \times 5 \times 4$

$= \frac{1}{2} \times 20 = 10$

So, the area is 10 sq ft.

Example 2 Find the area.



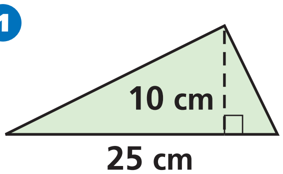
Area $= \frac{1}{2} \times (b_1 + b_2) \times h = \frac{1}{2} \times (3 + 6) \times 3$

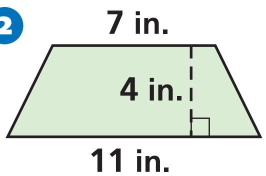
$= \frac{1}{2} \times (9) \times 3 = 4.5 \times 3 = 13.5$

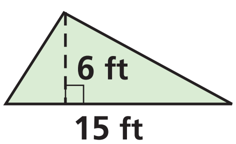
So, the area is 13.5 sq m

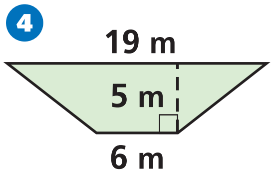
Check for Understanding

Find the area of each figure.

1. 

2. 

3. 

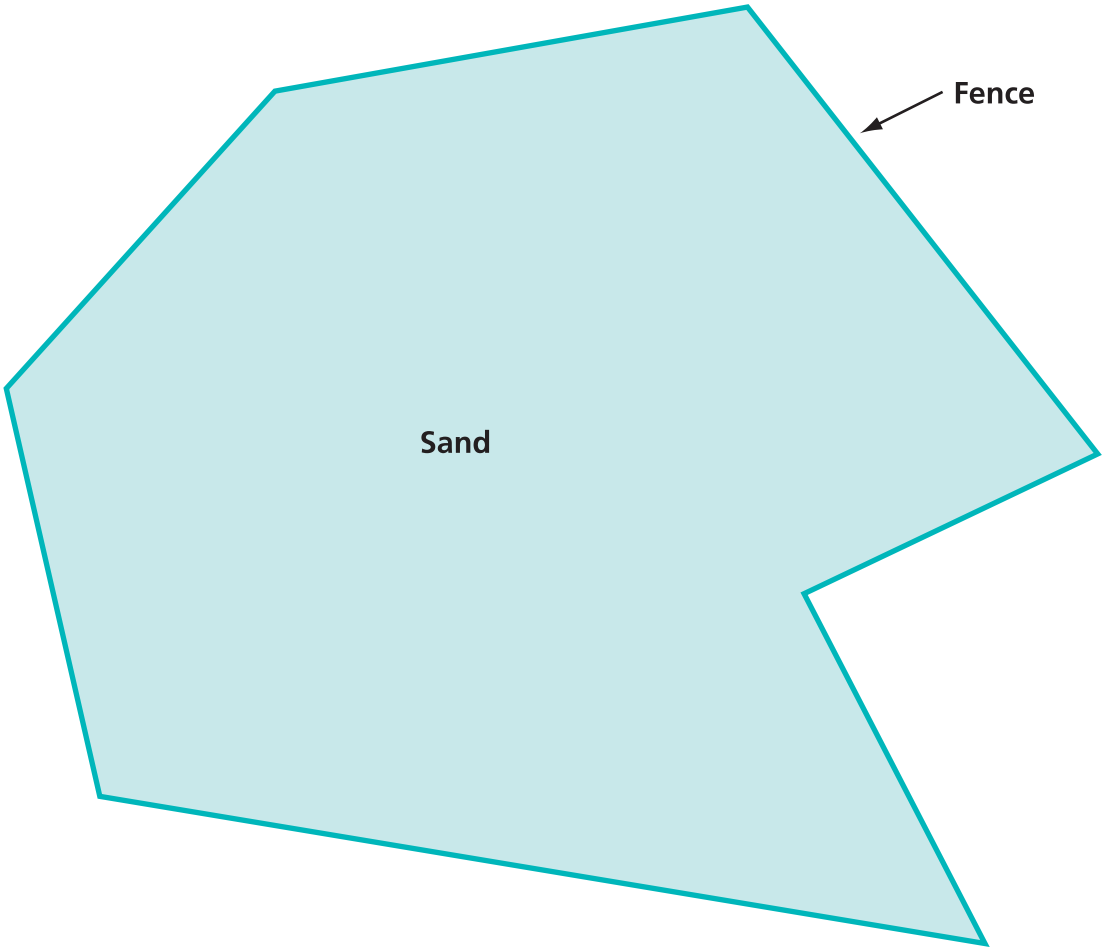
4. 

Chapter 10

Lesson 6

EXPLORE
Area and Perimeter of an Odd-Shaped Figure

Some of the people of Oddtown want to build a new playground on an odd-shaped piece of land. They will put a fence around it and cover the entire area of the playground with sand.



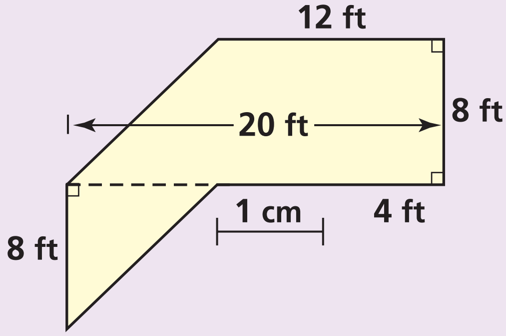
Use Activity Master 93 and tools such as scissors, a pencil, and a ruler to answer the questions below.

- ✔ You know how to find the area of a triangle.
  How could you figure out the area of the playground?

- ✔ How would you figure out how much fencing is needed?

REVIEW MODEL
Problem Solving Strategy
Solve a Simpler Problem

Charlotte drew this sketch to help her figure out how much carpet she needs to cover the floor of her playroom. What is the area of the playroom?



Strategy: Solve a Simpler Problem

Read to Understand

What do you know from reading the problem?

Charlotte has drawn a sketch of the playroom she wants to carpet.

What do you need to find out?

the area of the playroom

Plan

How can you solve this problem?

You can solve a simpler problem by splitting the odd-shaped playroom into polygons that have areas you know how to find.

Solve

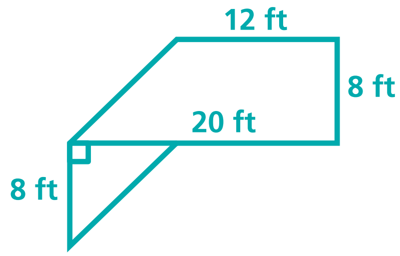
How can you split the sketch to help you solve a simpler problem?

You can split the figure into a trapezoid and a triangle (or into a rectangle and a parallelogram). Then you can use formulas to find the areas of the polygons.

Check

Look back at the problem. Did you answer the question that was asked? Does the answer make sense?

Two of Many Possible Ways



Area of the Trapezoid

$A = \frac{1}{2} \times (20 + 12) \times 8 =$

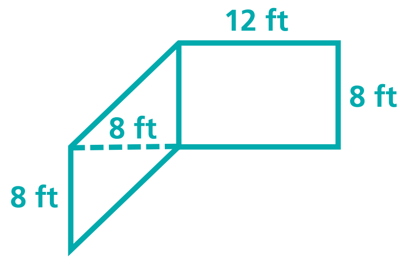
$\frac{1}{2} \times (32) \times 8 = 128$

Area of the Triangle

$A = \frac{1}{2} \times 8 \times 8 = \frac{1}{2} \times 64 = 32$

Area of Playroom:

128 sq ft + 32 sq ft = 160 sq ft



Area of the Rectangle

$A = 12 \times 8 = 96$

Area of the Parallelogram

$A = 8 \times 8 = 64$

Area of Playroom:

96 sq ft + 64 sq ft = 160 sq ft

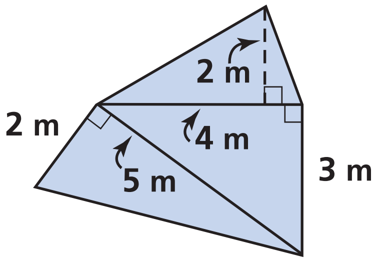
Problem Solving Strategies

- ✔ Act It Out
- ✔ Draw a Picture
- ✔ Guess and Check
- ✔ Look for a Pattern
- ✔ Make a Graph
- ✔ Make a Model
- ✔ Make an Organized List
- ✔ Make a Table
- ✔ **Solve a Simpler Problem**
- ✔ Use Logical Reasoning
- ✔ Work Backward
- ✔ Write an Equation

Problem Solving Practice

Use the strategy *solve a simpler problem* to solve.

1. Erica drew this sketch of a pen she made for her pet rabbit. What is the area of the pen?



2. Doug earns $15 an hour. He worked 5.5 hours on Monday, 7 hours on Tuesday, 4.5 hours on Wednesday, and 3 hours on Thursday. How much did he earn those four days?

Mixed Strategy Practice

Use any strategy to solve. Explain.

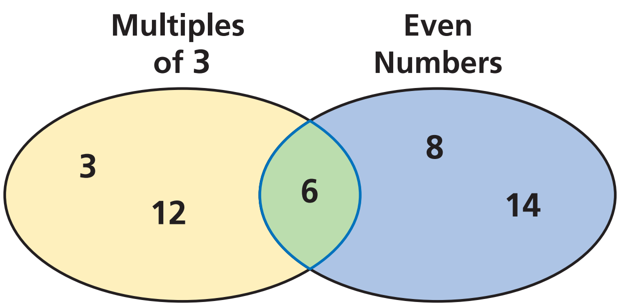
3. Four children want to share three muffins equally. How much will each child get?

4. The sum of two numbers is 32. Their product is 240. What are the two numbers?

5. A pet store has 148 fish. There are the same number of fish in each of 8 aquariums and 12 fish in another aquarium. How many fish are in each of the 8 aquariums?

6. The total rainfall last week was 4.6 inches. For the first 3 days it did not rain at all. On the next three days it rained 0.6 inch each day. How much did it rain on the last day?

For 7–9, use the diagram.



7. What color is the part of the diagram where you would write 15?

8. There are two numbers in the blue section of the diagram. Name three other numbers you could write in the blue section?

9. Describe the numbers that belong in the green section of the diagram.

Chapter 10 Vocabulary

Choose the best vocabulary term from Word List A for each sentence.

1. The measurement of space inside a plane figure is called the __?__.
2. A quadrilateral with exactly one pair of parallel sides is a(n) __?__.
3. A closed plane figure formed by three or more line segments is called a(n) __?__.
4. The distance from the base to the farthest point of a plane figure is the __?__ of the figure.
5. A(n) __?__ has opposite sides that are both parallel and congruent.
6. A rectangle with four sides of equal length is a(n) __?__.
7. Two __?__ lines intersect to form four right angles.
8. A quadrilateral with four equal sides is a(n) __?__.
9. Sides of a polygon that have the same length are __?__.

Word List A

area
base
congruent
height
parallel
parallelogram
perimeter
perpendicular
polygon
rectangle
rhombus
right angle
scale
square
trapezoid

Complete each analogy using the best term from Word List B.

10. Index card is to corner as rectangle is to __?__.
11. Fence is to backyard as __?__ is to polygon.

Word List B

area
parallel
perimeter
right angle

Talk Math

Use the vocabulary terms *base*, *height*, and *perpendicular* to discuss with a partner what you have just learned about area.

12. How can you measure the base and height of a parallelogram and then use those measurements to find its area?
13. How can you measure the base and height of a triangle and then use those measurements to find its area?
14. How can you measure the base and height of a trapezoid and then use those measurements to find its area?

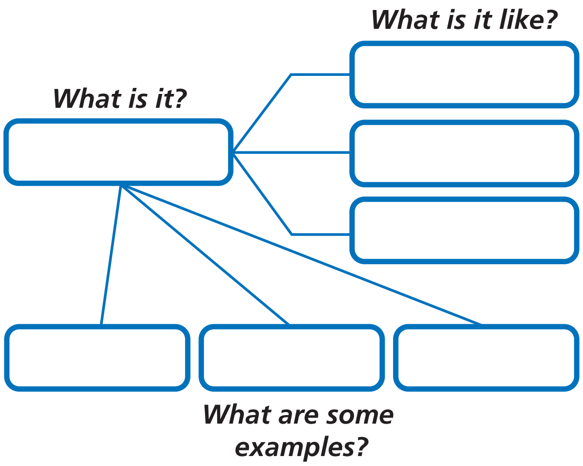
Word Definition Map

15 **Create a word definition map for the word *perimeter*.**

A What is it?

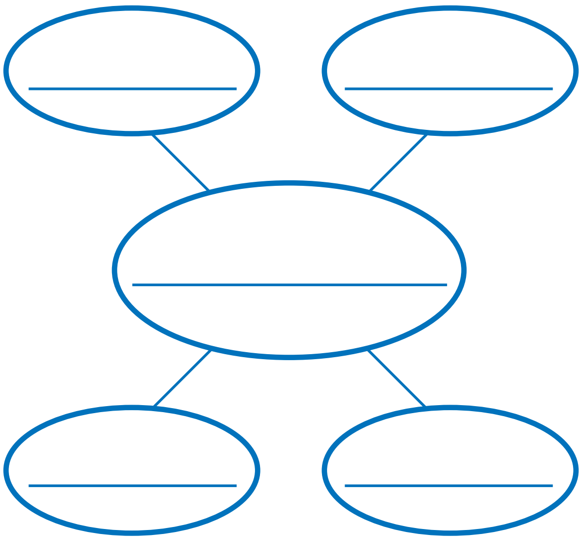
B What is it like?

C What are some examples?



Concept Map

16 **Create a concept map using the word *area*. Use what you know and what you have learned about area of a triangle, parallelogram, trapezoid, and irregular figures.**



What's in a Word?

BASE This word has many meanings in the English language. It can be first, second, or third *base* in baseball. It can be the bottom part of a pillar, lamp, or platform. It can be a military camp or fort.

Base also has more than one meaning in mathematics. In the expression 4^3 (which means the product of three 4s, or $4 \times 4 \times 4$), the number 4 is the *base*, and 3 is the exponent. In geometry, the *base* is one side of a polygon. In a triangle, parallelogram, or trapezoid, the height and *base* are always perpendicular.

In all of the definitions, the *base* relates in some way to place or position.

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GAME

Perimeter Race

Game Purpose
To practice finding perimeters of rectangular figures

Materials
- Activity Master 88: *Directions Spinner*
- Activity Master 89: *Centimeter Graph Paper*
- Pencil and paper clip

How To Play The Game

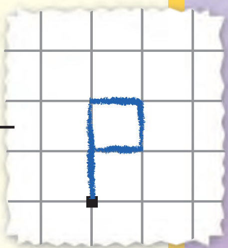
1. This is a game for 2 players. Each player starts at one of the dots on the graph paper.

2. Take turns. Spin the spinner to find your direction.
   - If the pointer lands on "Free," you choose the direction.
   - If the pointer lands on "Free: 2 cm," you choose the direction, but you must extend your path 2 centimeters in that direction.

   Start a path by drawing a line from the dot according to your spin. On your next turn, extend your path from where you left off.

3. You lose your turn if you cannot extend your path without retracing a path, crossing the boundary of a region, or leaving the grid.

   If you cannot move in any direction, you may begin a new path from any point on your path so far.



4. Draw your path until you close a region. Its perimeter is your score (even if the perimeter includes lines drawn by the other player). Write your initials in your completed figure for scoring and so you don't try to draw a path through it later.

5. After you have closed a region, continue your path from any point on your path so far that is not inside another region. Draw as many regions as possible. Add up all their perimeters as you go. You win if you have the greater total when time is called.

GAME

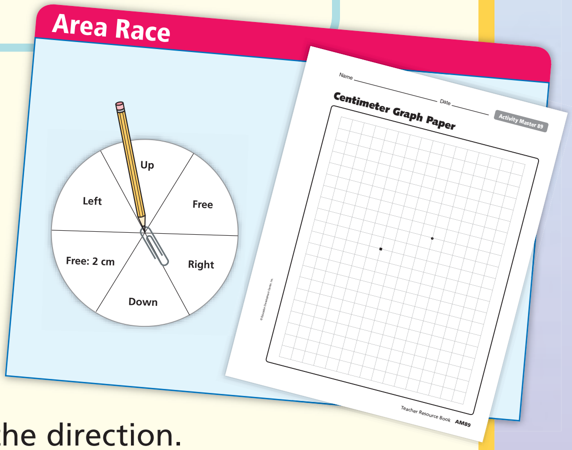
Area Race

Game Purpose

To practice finding areas of rectangular figures

Materials

- Activity Master 88: *Directions Spinner*
- Activity Master 89: *Centimeter Graph Paper*
- Pencil and paper clip



How To Play The Game

1. This is a game for 2 players. Each player starts at one of the dots on the graph paper. The goal is to get the greater sum of areas.

2. Take turns. Spin the spinner to find your direction.
   - If the pointer lands on "Free," you choose the direction.
   - If the pointer lands on "Free: 2 cm," you choose the direction, but you must extend your path 2 centimeters in that direction.

   Start a path by drawing a line from the dot according to your spin. On your next turn, extend your path from where you left off.

3. You lose your turn if you cannot extend your path without retracing a path, crossing the boundary of a region, or leaving the grid.

   If you cannot move in any direction, you may begin a new path from any point on your path so far.

4. Draw your path until you close a region. Its area is your score (even if the perimeter includes lines drawn by the other player). Write your initials inside for scoring and so you don't try to draw a path through it later.

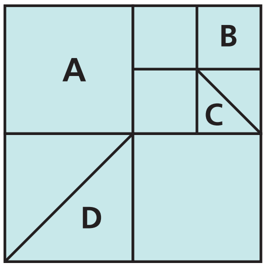
5. After you have closed a region, continue your path from any point on your path so far that is not inside another region. Draw as many regions as possible. Add up all their areas as you go. You win if you have the greater total when time is called.

CHALLENGE

Area, Area, Area

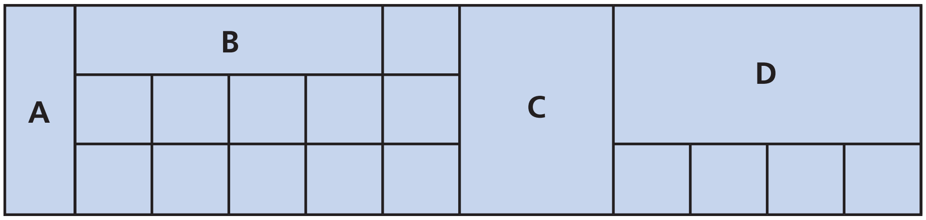
Use what you have learned about area, division, and fractions to find the area of each part of the figure.

1 Area of the square = 64 sq in.



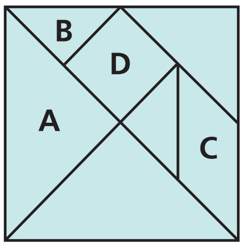
Area of **A** = ■ Area of **B** = ■ Area of **C** = ■ Area of **D** = ■

2 Area of the rectangle = 144 sq cm



Area of **A** = ■ Area of **B** = ■ Area of **C** = ■ Area of **D** = ■

3 Area of the tangram puzzle = 24 sq in.



Area of **A** = ■ Area of **B** = ■ Area of **C** = ■ Area of **D** = ■