Chapter 11 Geometry

Dear Student,

Think of all the kinds of figures you have seen! Some figures are two-dimensional.

You can find ways in which some of these figures are alike.

- Which figures have only straight sides?
- Which figures have exactly 6 straight sides?
- Which figures have right angles?

Some figures are three-dimensional.

In this chapter, you will learn ways to describe figures using attributes (they tell in which ways figures— and other things—are alike or different). You will also learn the names of some figures and explore characteristics of figures.

Mathematically yours,
The authors of *Think Math!*

Monumental Geometry

Have you ever visited or seen photos of our nation's capital, Washington, D.C.? Many buildings there honor past presidents of the United States. The Thomas Jefferson Memorial is a tribute to our third president, Thomas Jefferson, who was also the author of The Declaration of Independence.

FACT·ACTIVITY 1

Use the picture below. Answer the following questions about the figures outlined in red.

1. Draw each figure outlined in red. Name the figures.
2. Draw a line of symmetry for each figure. Which of the outlined figures has more than one line of symmetry?
3. Which figures have parallel sides?
4. Which figure has two pairs of parallel sides?
5. Which figure has a right angle?
6. Which figures have no right angles?

Jefferson Memorial

Visitors to Washington, D.C., can also see the Washington Monument, and the Lincoln Memorial. A modern building houses the National Gallery of Art.

FACT·ACTIVITY 2

Look for three-dimensional figures in the photos. Write the name of the photo to answer Problems 1 and 2.

1 Which photos have figures that represent pyramids? Describe where the pyramids appear.

2 Which photo shows figures that represent cylinders? Describe where the cylinders appear.

3 How would you describe the three-dimensional figures of the National Gallery of Art building?

National Gallery of Art

Lincoln Memorial

CHAPTER PROJECT

Think about historical places in your community. Consider the first library, first post office, or the first school. Research a historical landmark. Using blocks or other materials, create a model of the landmark. Observe the structure from different sides. Name the three-dimensional figures in the structure. Describe the two-dimensional figures on each side. In your description, use the terms *faces*, *edges*, *vertices*, *sides*, and *congruent*.

EXPLORE
Exploring Parallel Sides

Two sides of a quadrilateral are parallel. Are the other two sides also parallel? Complete Steps 1 through 6 to find out what affects the answer.

Step ❶
Tape a straw to a large piece of paper so that it is slanted: **not** horizontal (like this: ▬) or vertical (like this: ▯).

Step ❷
Tape another straw that is the same length to the paper so that it is **parallel** to the first straw. (They form lines that never cross and are always the same distance apart.) Leave lots of room between the straws.

Step ❸
Use a ruler to draw 2 straight lines that connect the ends of the straws. This makes a closed figure.

Step ❹
Tape a straw to a second piece of paper so it is **not** horizontal or vertical.

Step ❺
Tape a straw that is a **different** length to the paper so it is parallel to the first straw.

Step ❻
Create another figure with **4 straight sides** by drawing 2 straight lines to connect the ends of the straws.
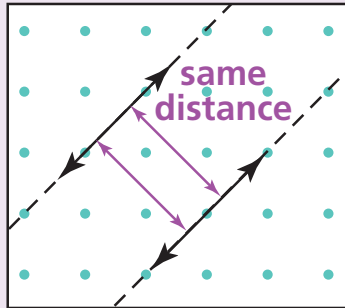
Compare the two figures you made.
Are the sides you drew for each figure parallel?

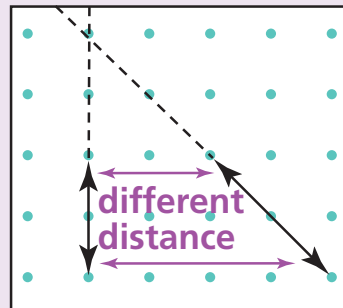# REVIEW MODEL
Identifying Parallel Lines

You can decide if a pair of lines is parallel. Look to see if the two lines will never cross or if they are always the same distance apart.

If I extend the lines will they ever cross?

Are the lines always the same distance apart?

The lines will never cross, and they are always the same distance apart. So, the lines are **parallel.**
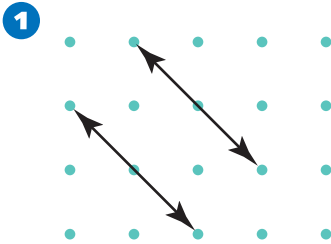

If I extend the lines will they ever cross?

Are the lines always the same distance apart?

The lines will cross, and they are not always the same distance apart. So, the lines are **not parallel.**

✔ Check for Understanding

Write *parallel* or *not parallel* to describe the pair of lines.
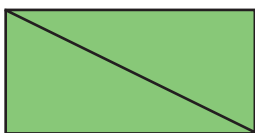
1

2

3
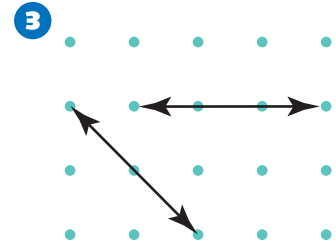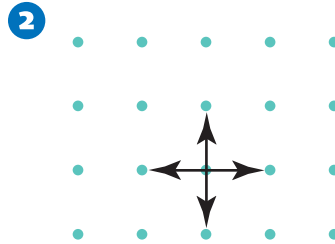
4 Draw a pair of parallel lines. You may use a ruler to help you.

5 Draw a pair of lines that are **NOT** parallel. You may use a ruler to help you.

EXPLORE
Exploring Polygons

**Part 1** **What figures can you make from two triangles?**

**A** On a rectangular card, use a ruler to draw a diagonal line from one corner to another like this:

B Cut the rectangle along the line you drew. Check to make sure the two triangles are congruent.

C See how many different figures you can make by placing these two parts next to each other with two congruent sides matching exactly. Trace each figure you make on a separate piece of paper.

**Part 2** **What figures can you make from a trapezoid and a triangle?**

A Fold a rectangular card to divide its long sides exactly in half as shown by the dashed line below. Use a ruler to draw a line from the end of the fold to the corner like this:
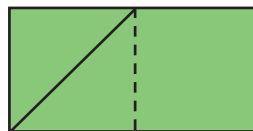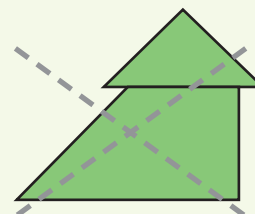
B Cut the card along the line you drew. You should have a triangle and a trapezoid.

C See how many different figures you can make placing these two parts next to each other with two congruent sides matching exactly. Trace each figure you make on a separate piece of paper.
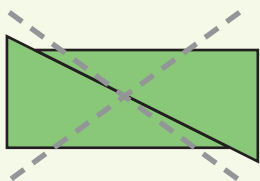
NOT OK
congruent sides touching, but not matching
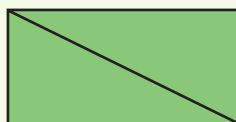
OK
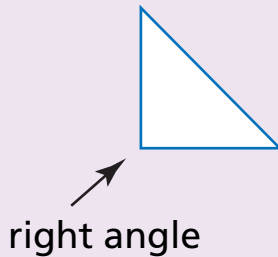**congruent sides matching**

NOT OK
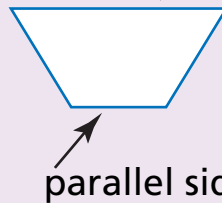**non-congruent sides touching**

REVIEW MODEL
Sorting Polygons

You can sort figures by different attributes, such as the number of sides, the size of the angles, and the number of pairs of parallel sides.
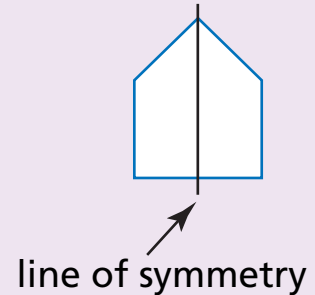
right angle

This **triangle** has 3 sides and 1 right angle.

parallel sides

parallel sides

This **quadrilateral** has 4 sides, 1 pair of parallel sides, and no right angles.
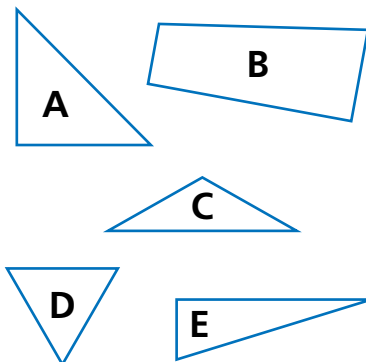
line of symmetry

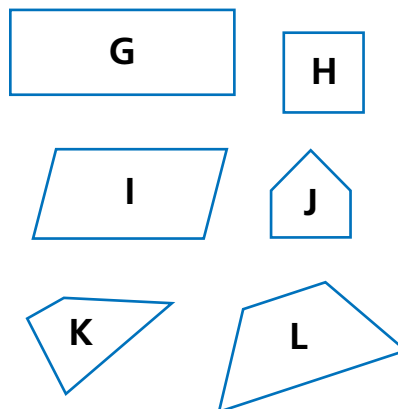This **pentagon** has 5 sides and 1 line of symmetry.

✔Check for Understanding

List the figures that belong in each group.

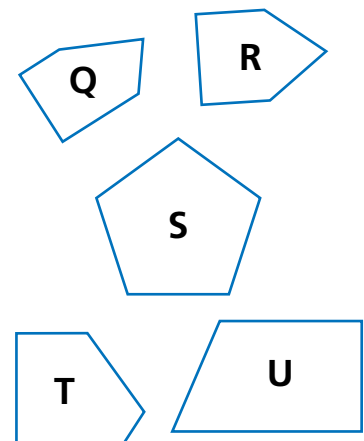**1** triangles with no right angles

A B C D E

2 quadrilaterals with at least 1 pair of parallel sides

G H I J K L

3 pentagons with at least 1 line of symmetry

Q R S T U

EXPLORE
Going on a Figure Safari

Which figures from the class Figure Zoo match the clues?

> **For 1 to 7, list the letters of all the figures that belong. Try standing each figure on different faces to see if there is any way it might fit the clues.**

1 All my faces are rectangles.
Only two of those rectangles are squares.

2 At least three of my faces are triangles.

3 Two of my faces are parallel and congruent to each other.
All my other faces are parallelograms.

4 All my faces are congruent.

5 Two of my faces are parallel and congruent to each other.
All my other faces are not parallelograms.

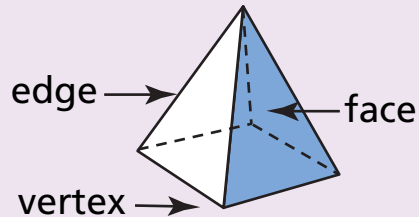**6** All my faces have at least two lines of symmetry.

7 My top and bottom faces are congruent.
All my other faces are rectangles.

REVIEW MODEL
Comparing Three-Dimensional Figures

You can compare three-dimensional figures by describing the faces, edges, and vertices.

Example A: Pyramid

edge → ← face

vertex →

Step ❶

Write the names of the two-dimensional figures for the faces and count the number of each kind of face.

Faces:
1 square and 4 triangles

Step ❷

Count the number of edges and vertices.

Edges: 8   Vertices: 5

Example B: Prism

edge → ← face

← vertex

Step ❶

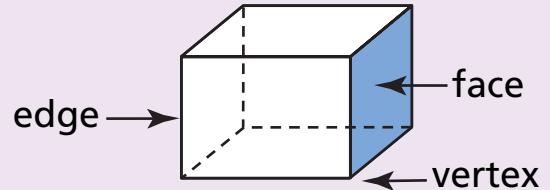Write the names of the two-dimensional figures for the faces and count the number of each kind of face.
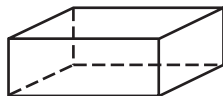
Faces:
6 rectangles

Step ❷

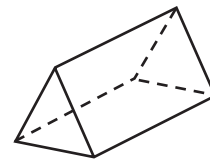Count the number of edges and vertices.

Edges: 12   Vertices: 8

✔Check for Understanding

Describe each three-dimensional figure. Identify the faces and the number of edges and vertices.

❶

❷

REVIEW MODEL
Problem Solving Strategy
Look for a Pattern

Troy sorted some three-dimensional figures into two groups.

Group 1
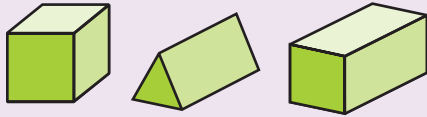
Group 2
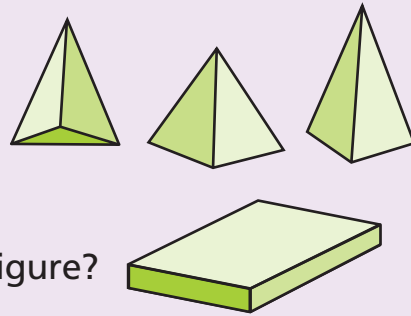
Into which group should Troy place this figure?

Strategy: Look for a Pattern

Read to Understand

What do you need to find out?

Where Troy should place the next figure

Plan

How can you solve the problem?

You can look for a pattern.

Solve

How can you look for a pattern to solve the problem?

Look to see how the figures in each group are alike. The figures in group 1 are prisms. The figures in group 2 are pyramids. The next figure is a prism, so it should be in group 1.

Check

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

Problem Solving Practice

Look for a pattern to solve.

1 Anita wants to find out the date of her friend's birthday. She knows it is the fifth Saturday in December. She knows that the dates of the first three Saturdays in December are 2, 9, and 16. What is the date of her friend's birthday?

2 Yoshi is making a pattern. **G ꓨ ꓫ ꓵ G**

If he continues the pattern in the same way, what will the next figure be?

Mixed Strategy Practice

Use any strategy to solve. Explain.

3 The length of one side of a rectangle is 2 centimeters. Another side of the same rectangle is twice as long. What is the perimeter of the rectangle?

4 Courtney saves $0.75 the first week, $1.25 the next week, and $1.75 the third week. If this pattern continues, how much money will she save in the fourth week?

5 The baseball team scored 2 runs in the first inning. After 3 innings, the team scored a total of 6 runs. What are all the ways the team could have scored 6 runs after 3 times at bat?

6 Last month, 4 students received an award for perfect attendance. This month, 3 times as many students received a perfect attendance award. How many more students received an attendance award this month than last month?

Vocabulary

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

1 Two lines that form right angles are ___?___ to each other.

2 Three edges of a three-dimensional figure meet at a(n) ___?___.

3 A(n) ___?___ is a special type of rectangle.

4 A(n) ___?___ has three sides.

5 You can fold a pentagon in half in five different ways and have both halves match exactly. This pentagon has five lines of ___?___.

6 A(n) ___?___ has two faces that are triangles and three faces that are rectangles.

7 A square corner is a(n) ___?___.

8 If two figures match exactly, then they are ___?___.

9 A two-dimensional pattern for a cube is called a(n) ___?___.

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

10 Triangle is to pyramid as ___?___ is to prism.

11 Poodle is to dog as rectangle is to ___?___.

🗨 Talk Math

Discuss with a partner what you have learned about geometry. Use the vocabulary terms *side, right angle, parallel,* and *perpendicular.*

12 How does a rectangle compare to a trapezoid?

13 How can you tell when two rectangles are congruent?

Word List A

congruent
flip
net
parallelogram
pentagon
perpendicular
polygon
quadrilateral
right angle
square
symmetry
triangle
triangular prism
turn
vertex

Word List B

face
net
quadrilateral
rectangle
triangle

Degrees of Meaning Grid

14 Create a degrees of meaning grid for the words *pentagon, polygon, quadrilateral, rectangle, square, trapezoid,* and *triangle.*

General	Less General	Specific	More Specific

Word Line

15 Use what you know and what you have learned about geometry to create a word line for polygons. Use the number of sides from least to greatest for the sequence.

Words:

Sequence:

_____

What's in a Word?

?

RECTANGLE The word *rectangle* comes from an old Latin word that means "having a right angle." Today, *rectangle* means any quadrilateral with four right angles. A square is a special type of *rectangle.*

GO ONLINE
Technology
Multimedia Math Glossary
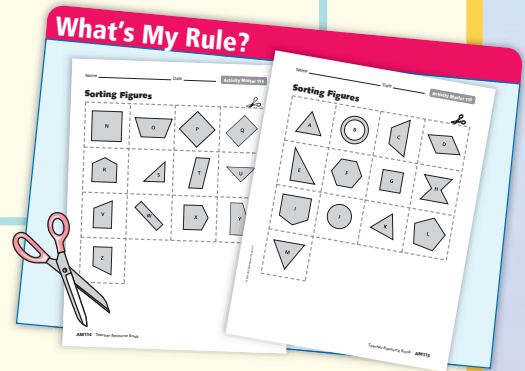**www.harcourtschool.com/thinkmath**

GAME

What's My Rule?

Game Purpose
To practice identifying the attributes of two-dimensional figures

Materials
- Activity Masters 113–114: Sorting Figures
- scissors

How To Play The Game

1. Play the game with a small group.
Sit around a table or desk. Cut out all the figures.

2. Take turns being the Rule Maker.
The Rule Maker secretly makes a rule for sorting the figures into two groups. One group of figures will follow the rule. The other group of figures will not.

   Possible rules:
   - 3 sides only
   - No right angles
   - Not 4 sides
   - At least 1 right angle

3. The Rule Maker puts the figures on the table one at a time. The first figure follows the rule. After that, he or she sorts the figures using the secret rule.

4. The winner is the first player who correctly names the rule the Rule Maker is using.

   Example: There are 2 groups of figures on the table.
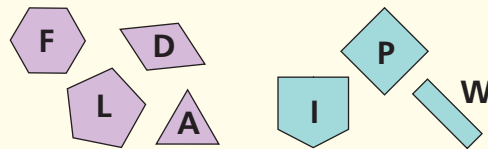
   Can you guess the rule? If you're the first player to say "No right angles," you win!

5. Play again. Keep playing until everyone has had a chance to be the Rule Maker.

GAME

Polygon Bingo

Game Purpose
To practice matching figures with their descriptions

Materials
- Activity Master 119: Bingo Attributes
- Activity Masters 120–123: Polygon Bingo
- Counters, scissors

Polygon Bingo

How To Play The Game

1 Play this game in a small group. Cut out the description cards from Activity Master 119. Place them face down. Each player will need a *Polygon Bingo* board and 20 counters.

2 Take turns picking a description card and reading it aloud.
- If a player has a figure on his or her board that matches the description, the player covers it with a counter.
- There might be more than one figure that matches the description, but you can cover only one figure for each description.

3 If you cover 5 figures in a row, a column, or a diagonal, say "Bingo!" Show your board. Does everyone agree that the winning figures match the descriptions that were read? If yes, you win! If no, keep playing until someone has "Bingo."

4 Clear the counters off the boards for each new game. Players may wish to trade Bingo boards.

CHALLENGE

The popular puzzle below is known as a tangram. Trace the puzzle. Then cut along the lines. There will be 7 pieces in all.

Now use the puzzle pieces to make all the squares you can. You know you can make a square using 1 piece, because 1 piece is a small square. You know you can make a square using all 7 pieces, because that is the shape of the puzzle. Can you make a square using 2 pieces? 3 pieces? 4 pieces? 5 pieces? 6 pieces?
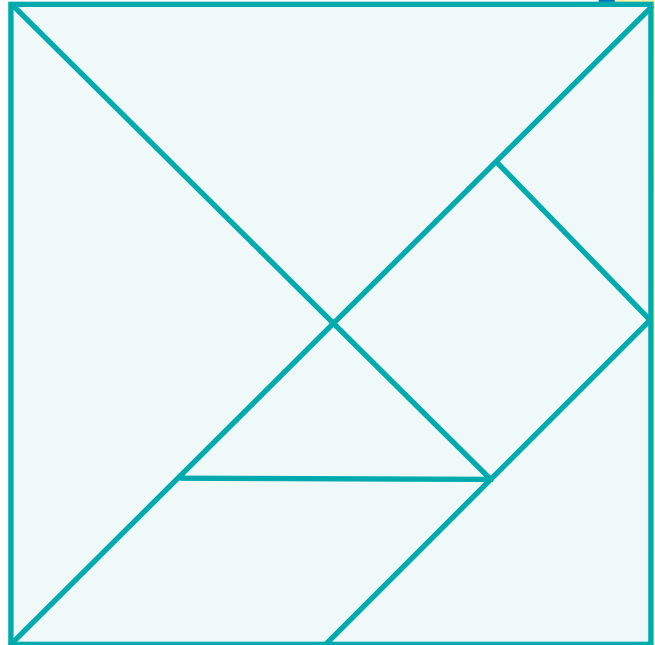
Copy and complete this table. Try to make each square. Good luck!

Can you make a square with	Yes or No	Draw the square if you can make it.
2 pieces?		
3 pieces?		
4 pieces?		
5 pieces?		
6 pieces?		