Classify Two-Dimensional Figures

LESSON 29

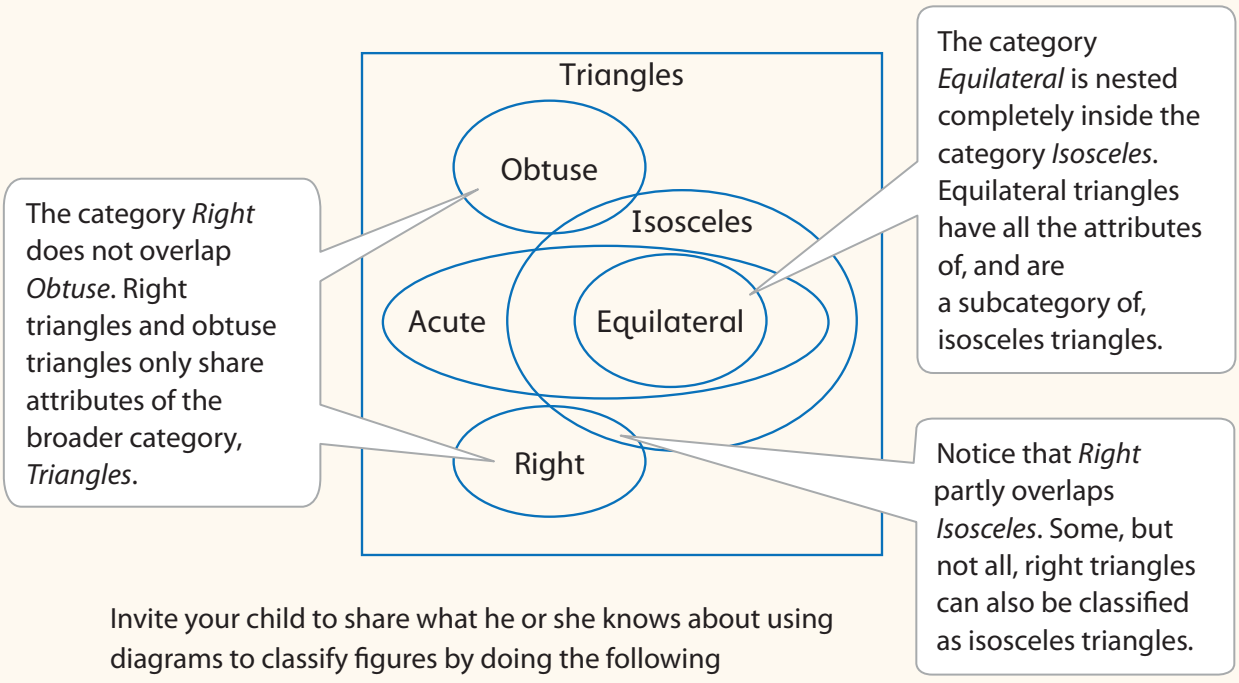
Dear Family,

This week your child is continuing to make diagrams to classify two-dimensional figures.

Your child will continue to explore how Venn diagrams and tree diagrams can be used to show relationships among categories of two-dimensional figures.

Figures can be grouped into categories by their attributes or properties, such as the number of their sides and angles, the length of their sides, and the measure of their angles. Your child knows all figures in a category share at least one attribute. While subcategories share the attribute(s) of the broader category, figures in subcategories have additional specific properties.

Your child knows how to use Venn diagrams or tree diagrams to show that one category is a subcategory of another. Now your child will use more complex diagrams to classify figures. The Venn diagram below shows "Triangles" as the broader category. The labeled ovals represent subcategories of triangles.



Invite your child to share what he or she knows about using diagrams to classify figures by doing the following activity together.

ACTIVITY CLASSIFYING TWO-DIMENSIONAL FIGURES

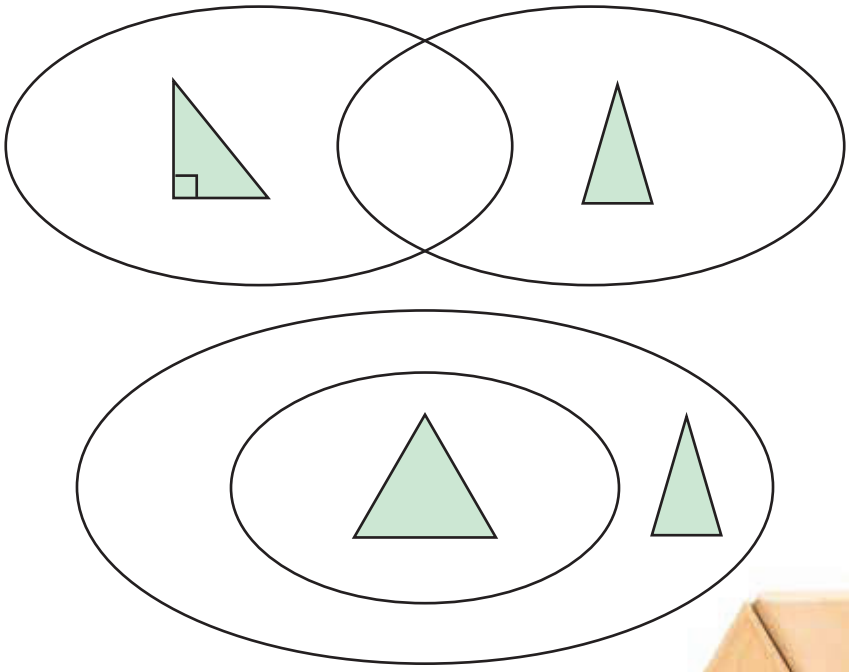
Do this activity with your child to classify two-dimensional figures.

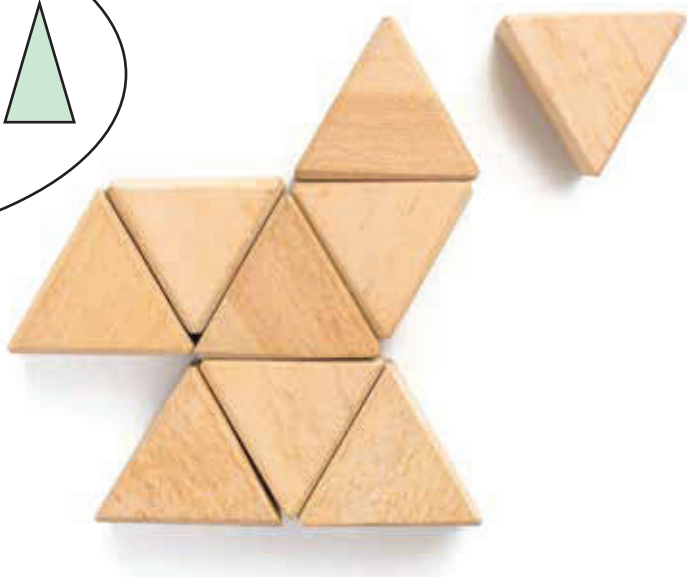
Work together with your child to describe how figures are classified in Venn diagrams.

- Look at the figures in the Venn diagrams below and talk about how the figures are related to each other.
- Work together to describe the attributes of the figures. Tell what attributes the figures do and do not share. The words in the box describe some attributes of figures that you might use in your discussion.

three sides	equilateral	isosceles
right angle	acute angle	obtuse angle
equal side lengths	different side lengths	

- Write category names in each oval to classify the shapes.





Explore Classifying Two-Dimensional Figures

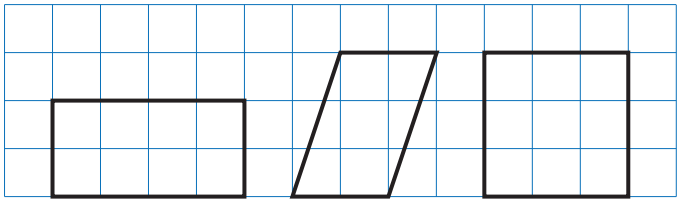
Learning Target

- Classify two-dimensional figures in a hierarchy based on properties.

SMP 1, 2, 3, 4, 5, 6, 7

Previously, you learned that attributes of a category are shared by its subcategories. Use what you know to try to solve the problem below.

Arrange the quadrilaterals shown below into a Venn diagram that shows a hierarchy of categories from most general to most specific. Label the categories represented by these shapes in your Venn diagram.



TRY IT

Math Toolkit

- geoboard
- rubber bands
- tracing paper
- grid paper
- rulers

DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: I started by . . .

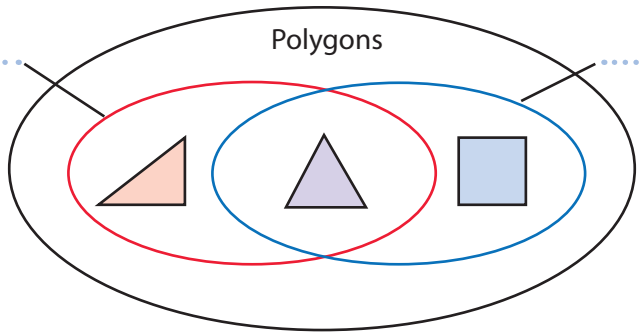
CONNECT IT

1 LOOK BACK

Explain how you organized the shapes in your Venn diagram.

2 LOOK AHEAD

In the Venn diagram below, the red and blue ovals represent subcategories of polygons. Three polygons are placed into the ovals, with one shape in both ovals.



a. What property is shared by the two shapes in the red oval?

b. What property is shared by the two shapes in the blue oval?

c. Use your answers to parts a and b to write subcategory labels for each oval.

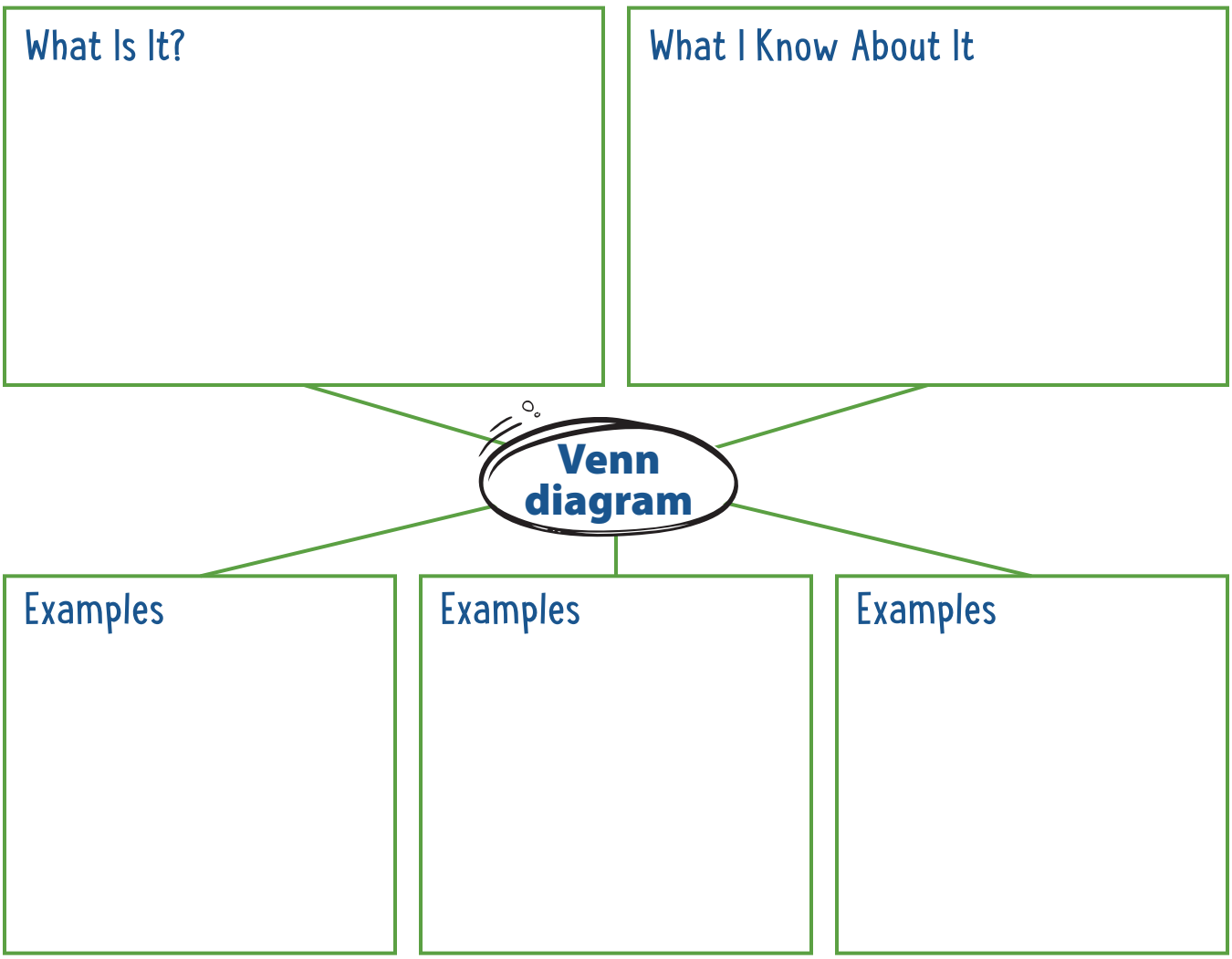
d. Why is the equilateral triangle inside of both the red and blue ovals?

3 REFLECT

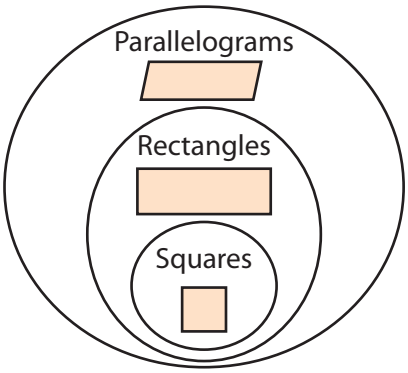
In a Venn diagram, what is true about two categories represented by ovals that overlap without one oval being completely inside the other?

Prepare for Classifying Two-Dimensional Figures

1 Think about what you know about Venn diagrams. Fill in each box.
Use words, numbers, and pictures. Show as many ideas as you can.

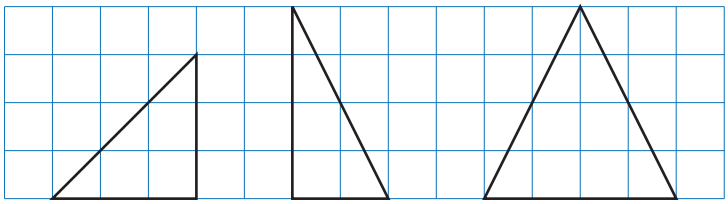


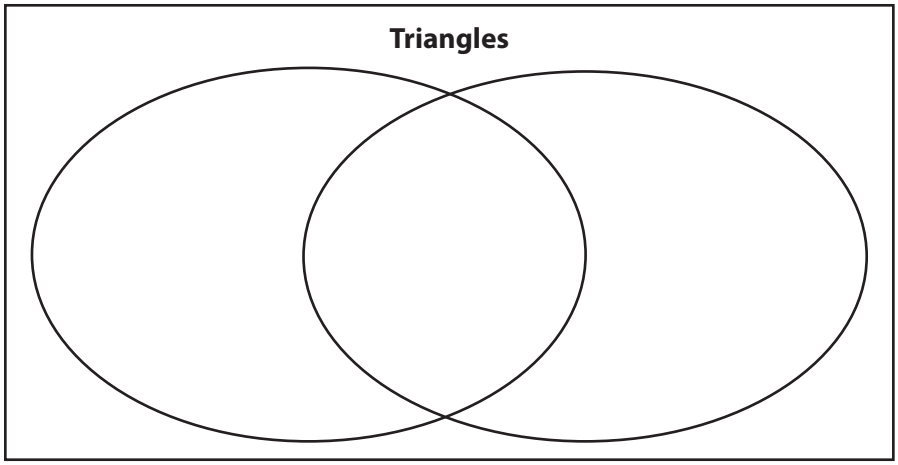
2 Look at the Venn diagram. Why is the square inside of all the ovals?



3 Solve the problem. Show your work.

Arrange the triangles below into the Venn diagram. Label each oval as a catgeory of triangles.





4 Check your answer. Show your work.

Develop Classifying Two-Dimensional Figures

Read and try to solve the problem below.

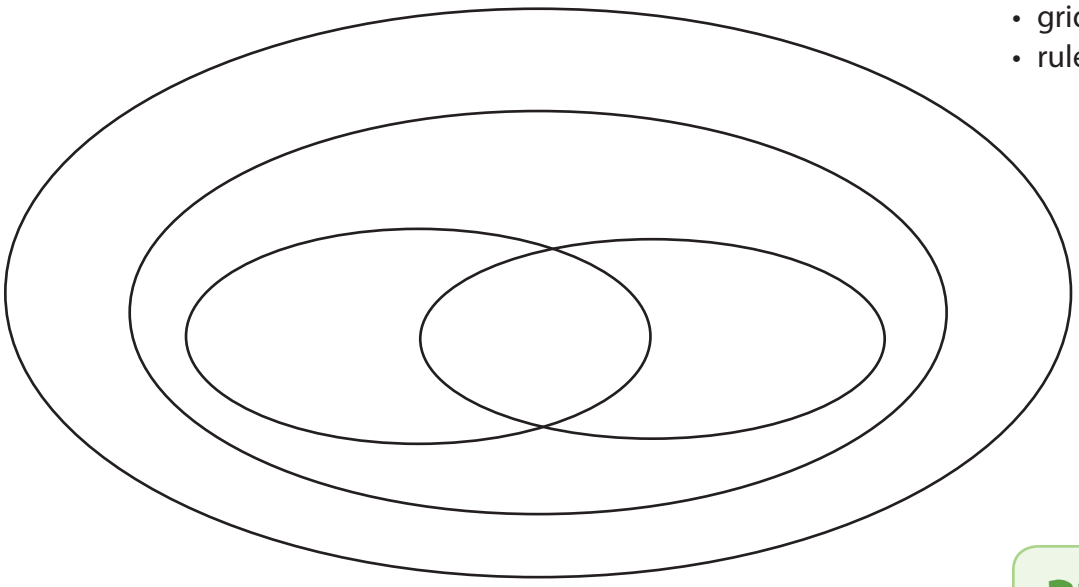
Sort these shapes into the Venn diagram below to show the relationships among parallelograms, squares, rectangles, rhombuses, and quadrilaterals.

Use at least one shape in each region of the diagram. Classify the shapes by labeling each region with the category name.

TRY IT

Math Toolkit

- geoboard
- rubber bands
- tracing paper
- grid paper
- rulers



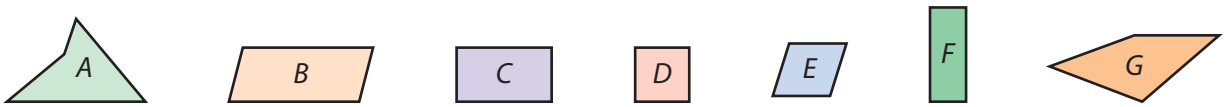
DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I knew . . . so I . . .

Explore ways to understand classifying two-dimensional figures using a Venn diagram.

Sort these shapes into a Venn diagram to show the relationships among parallelograms, squares, rectangles, rhombuses, and quadrilaterals.



Use at least one shape in each region of the diagram. Classify the shapes by labeling each region with the category name.

MODEL IT

You can use a table to compare properties of the categories of polygons.

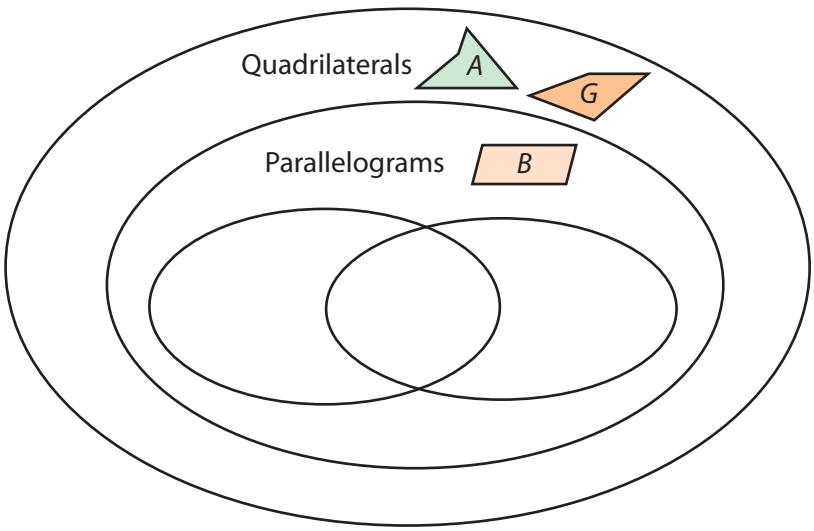
Property	Parallelograms	Quadrilaterals	Rectangles	Rhombuses	Squares
4 sides	×	×	×	×	×
2 pairs of parallel sides	×		×	×	×
2 pairs of sides of equal length	×		×	×	×
4 sides of equal length				×	×
4 right angles			×		×

MODEL IT

You can show the relationships among the categories with a Venn diagram.

Two regions of the Venn diagram are labeled and three of the shapes have been classified by placing them into the diagram.

Write the remaining category names and the letters for Figures *C*, *D*, *E*, and *F* in the diagram.



CONNECT IT

Now you will use the problem from the previous page to help you understand how to use Venn diagrams to classify two-dimensional figures.

1. Look at the Quadrilaterals column in the table and the placement of shapes *A* and *G* in the Venn diagram. Why are shapes *A* and *G* placed in the outermost oval?

2. Explain how the Venn diagram supports this statement: *All parallelograms are quadrilaterals, but not all quadrilaterals are parallelograms.*

3. Look at the table. Which categories share all the properties listed for parallelograms?

   How is this shown in the Venn diagram?

4. Look at the table. Which properties are not shared by rectangles and rhombuses?

   How is this shown in the Venn diagram?

5. Look at your Venn diagram. Why is Shape *D* inside all the ovals?

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for classifying two-dimensional figures? Explain.

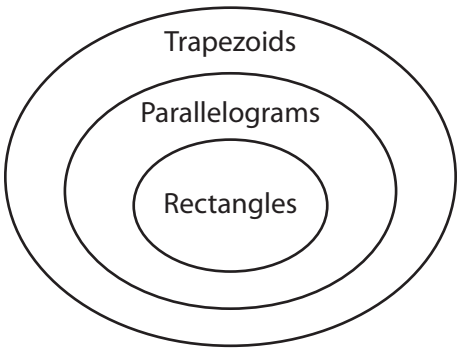
APPLY IT

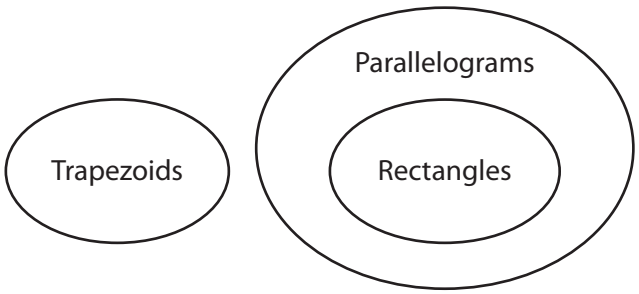
Use what you just learned to solve these problems.

7 Mathematicians define trapezoids in two different ways:

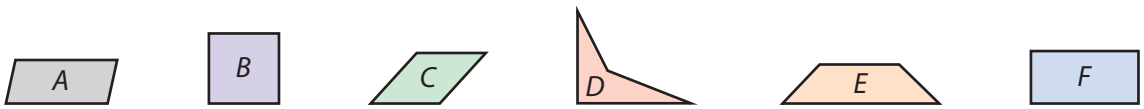
- **Trapezoids** are quadrilaterals with *exactly one pair* of parallel sides.
- **Trapezoids** are quadrilaterals with *at least one pair* of parallel sides.

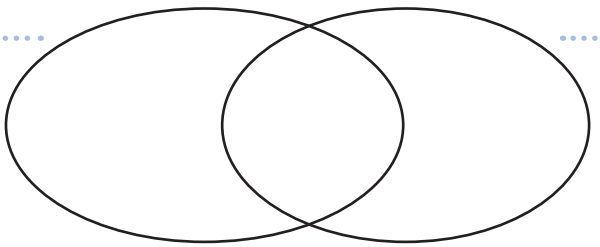
Write *exactly one pair* or *at least one pair* to show which definition of trapezoid was used to make each Venn diagram below.





8 Sort these shapes into the Venn diagram, based on properties of having parallel sides and having perpendicular sides. Write category labels for the two ovals.





9 Which definition in problem 7 lets you classify shape *A* in problem 8 as a trapezoid? Explain.

Practice Classifying Two-Dimensional Figures

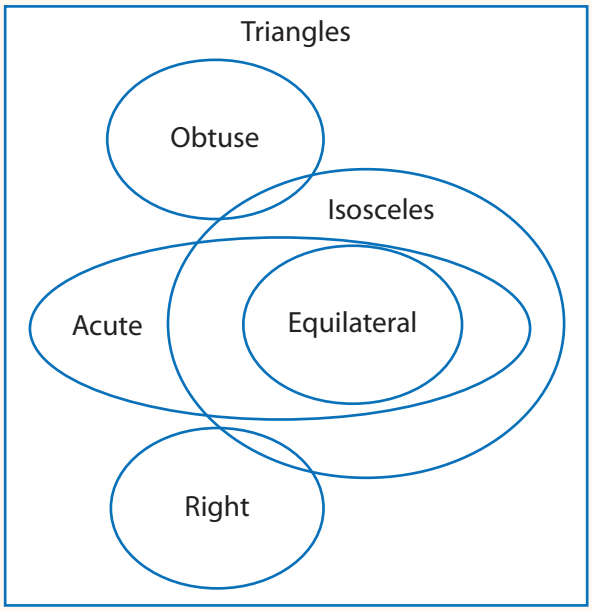
Study the Example showing how to use Venn diagrams to classify two-dimensional figures. Then solve problems 1–5.

EXAMPLE

You can use a Venn diagram to show the relationships between acute, right, obtuse, isosceles, and equilateral triangles.

You can plan your Venn diagram using a table describing properties of the triangles.

Triangle	Description
Acute	all acute angles
Right	2 acute angles and 1 right angle
Obtuse	2 acute angles and 1 obtuse angle
Isosceles	at least 2 sides of equal length
Equilateral	all sides equal length



1 Look at the Venn diagram above. Can a right triangle ever be an equilateral triangle? Explain.

2 Look at the Venn diagram on the previous page. Write a statement about the relationship between acute triangles and isosceles triangles.

3 Look at the Venn diagram on the previous page. Write a statement about the relationship between acute triangles and equilateral triangles.

4 Draw a Venn diagram in the space below to show the relationships among the categories of isosceles, scalene, and equilateral triangles within the broader category, Triangles.

Triangles

5 Determine whether each statement is *True* or *False*. Draw a picture to help if needed.

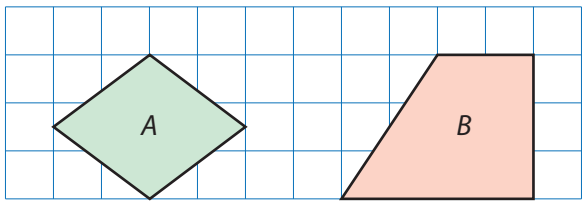
	True	False
A scalene triangle is never isosceles.	Ⓐ	Ⓑ
A right triangle is sometimes equilateral.	Ⓒ	Ⓓ
A right triangle is never isosceles.	Ⓔ	Ⓕ
A scalene triangle can be a right, obtuse, or acute triangle.	Ⓖ	Ⓗ

Develop Classifying Two-Dimensional Figures with Tree Diagrams

Read and try to solve the problem below.

Make a tree diagram to show the hierarchy of the following shapes based on their properties: rhombus, trapezoid, polygon, square, quadrilateral, rectangle, parallelogram. Use the exclusive definition of trapezoid in your diagram: a trapezoid is a quadrilateral with exactly one pair of parallel sides.

Then, classify these shapes into as many categories as possible.



TRY IT

Math Toolkit

- geoboard
- rubber bands
- tracing paper
- grid paper
- rulers

DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: At first, I thought . . .

Explore ways to understand classifying two-dimensional figures using a tree diagram.

Make a tree diagram to show the hierarchy of the following shapes based on their properties: rhombus, trapezoid, polygon, square, quadrilateral, rectangle, parallelogram. Use the exclusive definition of trapezoid in your diagram: a trapezoid is a quadrilateral with exactly one pair of parallel sides.

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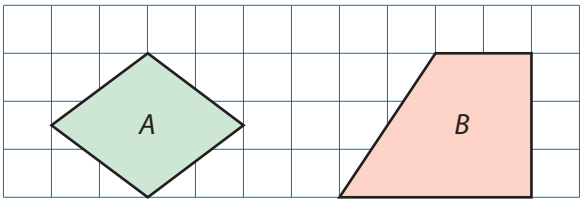
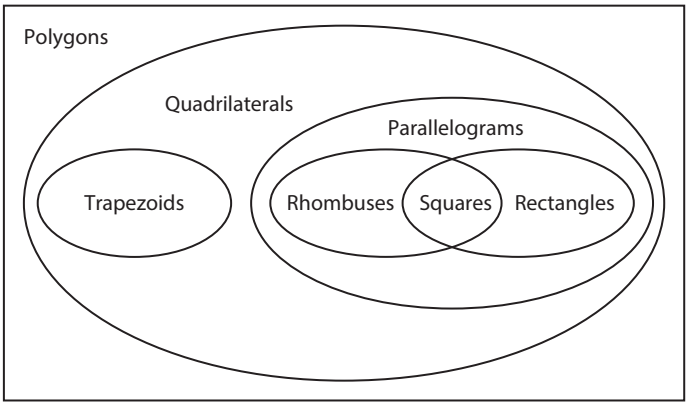


MODEL IT

You can use a Venn diagram to look at the hierarchy of the shapes.

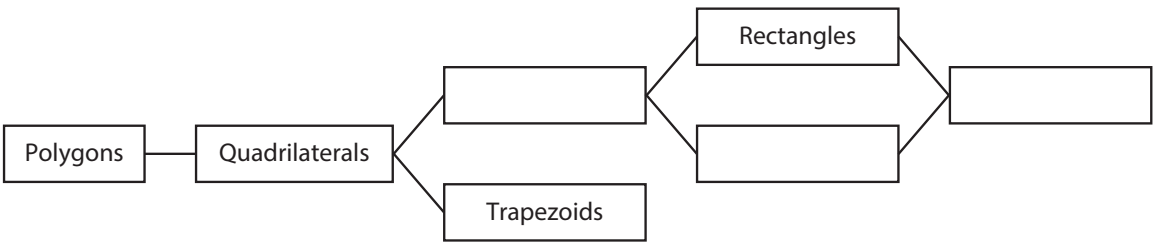


MODEL IT

You can show the hierarchy among shapes with a tree diagram.

This tree diagram has the most general category at the left (or top) and more specific categories as you go towards the right (or down). Each shape belongs in every category before it.

Write the remaining shape names in the diagram.



CONNECT IT

Now you will use the problem from the previous page to help you understand how to use tree diagrams to classify two-dimensional figures.

1. Look at the Venn Diagram. Which part of the diagram shows the most general category? Which part of the diagram shows the most specific category?

2. How is the tree diagram similar to the Venn diagram? How is it different?

3. How can you see all of the categories that a shape belongs to in a tree diagram? What are all of the categories that shape *A* belongs to?

4. Why do the branches that come off *Rectangles* and *Rhombuses* both lead to *Squares*?

5. Explain the relationship between the properties of categories when you move left or right (or up or down) in a tree diagram.

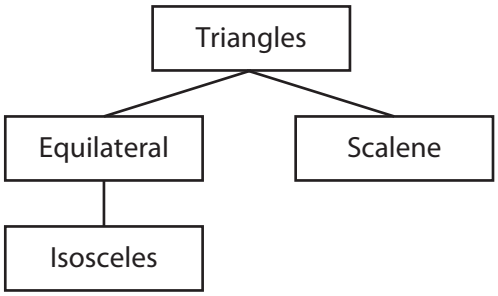
6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for classifying two-dimensional figures? Explain.

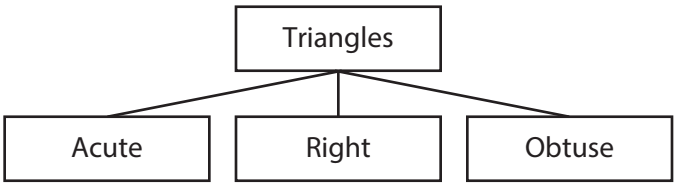
APPLY IT

Use what you just learned to solve these problems.

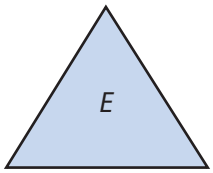
7 Cyrus made the following tree diagram to show the relationship among scalene triangles, equilateral triangles, and isosceles triangles. Is his diagram correct? Explain.



8 An equilateral triangle has three sides that have the same length. An equilateral triangle may also be called an equiangular triangle because each of the three angles has the same measure, 60°. Insert an additional category in the tree diagram for equiangular triangles. Explain.



9 Look at the tree diagrams in the two problems above. Shape *E* has all sides the same length. What are all categories of triangles to which this triangle belongs? Explain.



Practice Classifying Two-Dimensional Figures with Tree Diagrams

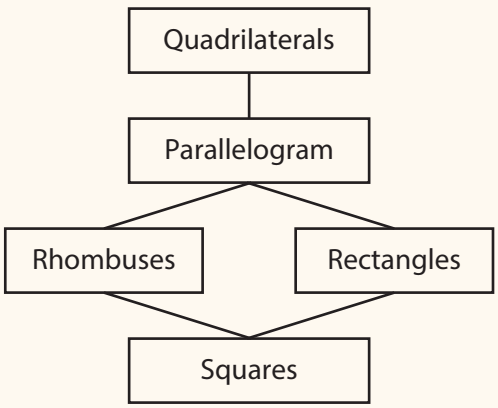
Study the Example showing how to use a tree diagram to classify two-dimensional figures. Then solve problems 1–5.

EXAMPLE

You can use a tree diagram to show the relationship between quadrilaterals, parallelograms, rectangles, squares, and rhombuses.

You can arrange your tree diagram using descriptions from a table of the properties of each quadrilateral.

Figure	Description
Quadrilateral	4 sides
Parallelogram	4 sides 2 pairs of parallel sides
Rhombus	4 sides 2 pairs of parallel sides 4 sides of equal length
Rectangle	4 sides 2 pairs of parallel sides 4 right angles
Square	4 sides 2 pairs of parallel sides 4 sides of equal length 4 right angles



1 Look at the tree diagram above. Write a statement about the relationship between rhombuses and squares.

Name: _____

2 Look at the tree diagram on the previous page. Can a rhombus ever be a rectangle? Explain.

3 Draw a tree diagram to show the relationship among the following categories: polygons, pentagons, quadrilaterals, parallelograms, trapezoids, rectangles, and squares. Use the inclusive definition of trapezoid: *a quadrilateral with at least one pair of parallel sides*.

4 How would your tree diagram in the previous problem be different if you used the exclusive definition for trapezoid? Explain.

5 Determine whether each statement is *always*, *sometimes*, or *never* true. Use the inclusive definition for trapezoid.

	Always	Sometimes	Never
A square is a parallelogram.	Ⓐ	Ⓑ	Ⓒ
A trapezoid is a rectangle	Ⓓ	Ⓔ	Ⓕ
A pentagon is a parallelogram.	Ⓖ	Ⓗ	Ⓘ
A trapezoid is a square.	Ⓙ	Ⓚ	Ⓛ

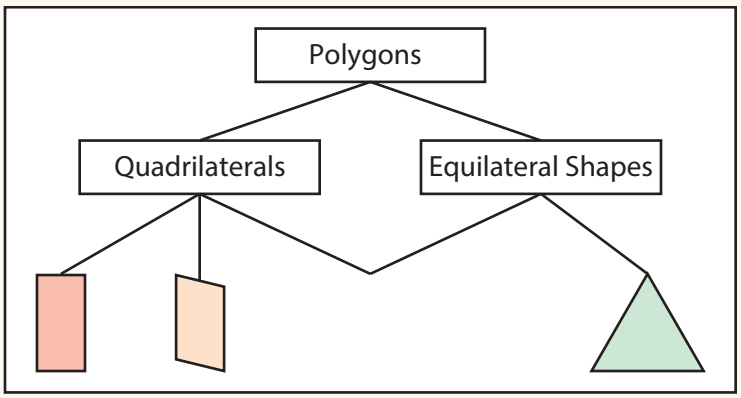
Refine Classifying Two-Dimensional Figures

Complete the Example below. Then solve problems 1–8.

EXAMPLE

Hugo classified polygons based on properties of having exactly four sides and having all sides equal in length.

Look at how Hugo placed three figures in a tree diagram.



Draw a shape that belongs to both branches of the tree diagram. What is the name of the shape you drew?

Solution

What shape has four sides and all sides equal in length?

PAIR/SHARE
How can this tree diagram be shown with a Venn diagram?

APPLY IT

1 Draw a Venn diagram or a tree diagram to show the relationships among quadrilaterals, polygons, trapezoids, and hexagons. Then write a statement about the relationship between quadrilaterals and trapezoids. Show your work.

What is the most general category in your diagram?

PAIR/SHARE
What does your diagram show about hexagons and quadrilaterals?

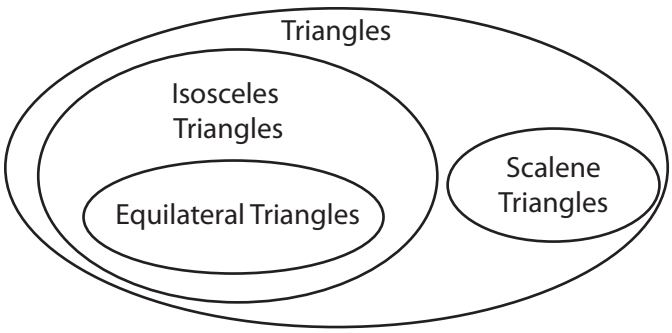
2 Draw a Venn diagram or tree diagram to show the relationships among these polygons.

Polygon	Description
Quadrilateral	polygon with exactly 4 sides
Trapezoid	quadrilateral with exactly 1 pair of parallel sides
Parallelogram	quadrilateral with 2 pairs of parallel sides

The table contains one of the definitions of a trapezoid.

PAIR/SHARE
How would the diagram change if the description of the trapezoid used the definition *quadrilateral with at least one pair of parallel sides?*

3 Look at the Venn diagram below.



Which statement is true?

Ⓐ An equilateral triangle is always an isosceles triangle.

Ⓑ An isosceles triangle is always an equilateral triangle.

Ⓒ Scalene and isosceles triangles share no attributes.

Ⓓ The label inside the largest oval could be *Acute Triangles*.

Brad chose Ⓑ as the correct answer. How did he get that answer?

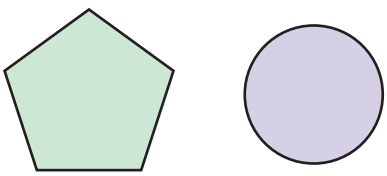
All triangles are three-sided polygons.

PAIR/SHARE
What would you say to Brad to help him understand his mistake?

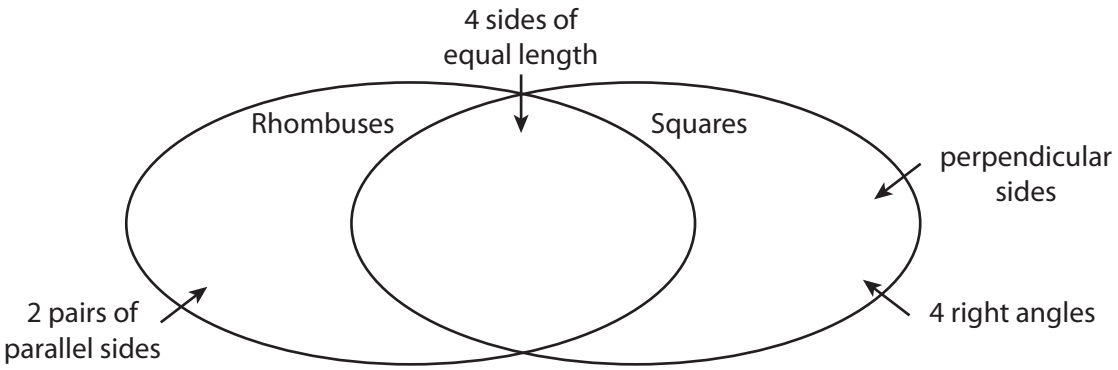
4 Draw a tree diagram to show the relationships among triangles, quadrilaterals, isosceles triangles, and polygons.

5 Use the diagram in problem 4. Write two different statements that describe relationships among the shapes.

6 Could you add the two shapes below to your diagram in problem 4? If so, where would you put them? Name each shape as you explain your thinking.



7 Saul drew a Venn diagram to show how rhombuses and squares are related. He used arrows to label each region with properties of shapes inside that region.



Part A Is Saul's Venn diagram correct? If not, what mistake did he make?

Part B Describe the relationship between rhombuses and squares.

8 MATH JOURNAL

A regular polygon has all sides of equal length. Sami says that all squares, equilateral triangles, and pentagons can be classified as regular polygons. Is Sami correct? Draw a Venn diagram and explain your thinking.

SELF CHECK Go back to the Unit 4 Opener and see what you can check off.