Explore Classifying Quadrilaterals

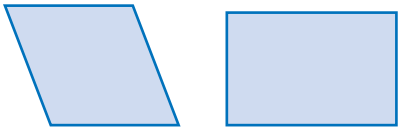
Learning Target

- Understand that shapes in different categories may share attributes, and that the shared attributes can define a larger category. Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

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

Previously you compared shapes and put them into groups. In this lesson you will learn how to group quadrilaterals. Use what you know to try to solve the problem below.

A rhombus is one kind of quadrilateral. A rectangle is another kind of quadrilateral. How are a rhombus and a rectangle the same? How are they different?



rhombus

rectangle

TRY IT

Math Toolkit

- geoboards
- rubber bands
- grid paper
- index cards
- sticky notes

DISCUSS IT

Ask your partner: Can you explain that again?

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

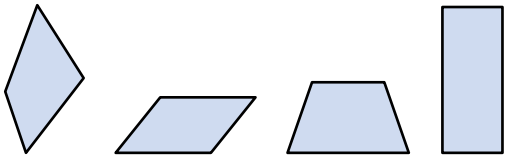
CONNECT IT

1 LOOK BACK

How are a rhombus and a rectangle alike? How are they different?

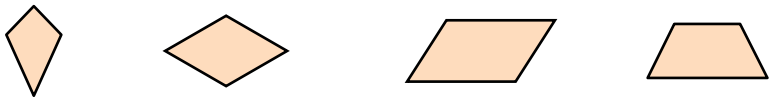
2 LOOK AHEAD

A quadrilateral is a shape with 4 sides and 4 angles. The shapes to the right are quadrilaterals. You can name a quadrilateral based on its attributes. An **attribute** is a way to describe a shape.



a. A quadrilateral is a **parallelogram** if it has the attributes *both pairs of opposite sides are the same length* and *opposites sides are parallel*. Sides are **parallel** if they are always the same distance apart.

Circle the parallelograms:

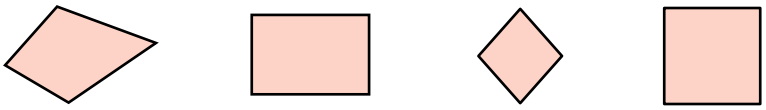


b. A quadrilateral is a rectangle if it has 4 right angles. A rectangle also has 2 pairs of opposite sides that are parallel and the same length.

Circle the rectangles:

c. A quadrilateral is a rhombus if it has 4 sides that are all the same length. A rhombus also has 2 pairs of parallel sides.

Circle the rhombuses:



3 REFLECT

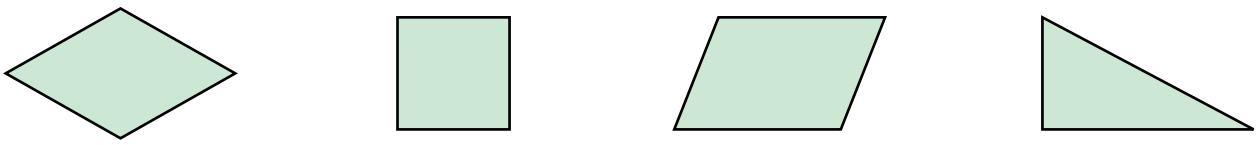
List 3 attributes a quadrilateral could have.

Prepare for Classifying Quadrilaterals

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

Word	In My Own Words	Example
quadrilateral		
attribute		
parallelogram		
rectangle		
rhombus		

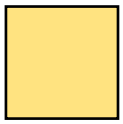
2 Circle the parallelograms. What other word above describes your circled shapes?



3 Solve the problem. Show your work.

A parallelogram is one kind of quadrilateral. A square is another kind of quadrilateral. How are a parallelogram and a square the same? How are they different?

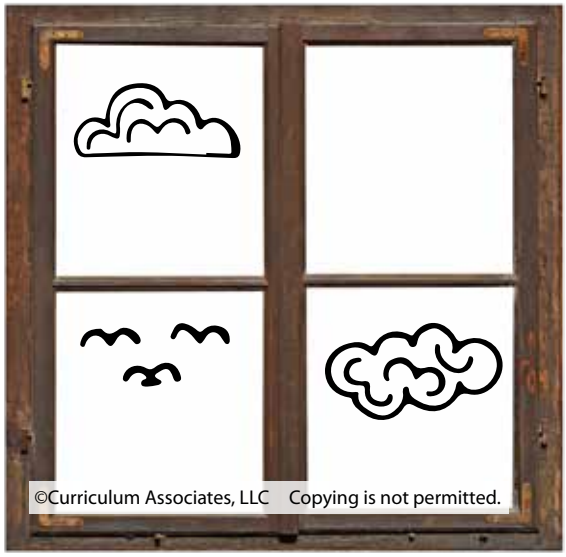
parallelogram



square

Solution

4 Check your answer. Show your work.



Develop Comparing Quadrilaterals

Read and try to solve the problem below.

Is a square a rectangle?

Is a rectangle a square?

TRY IT

Math Toolkit

- geoboards
- rubber bands
- grid paper
- dot paper
- colored pencils

DISCUSS IT

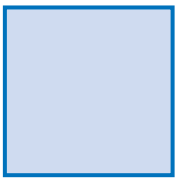
Ask your partner: Do you agree with me? Why or why not?

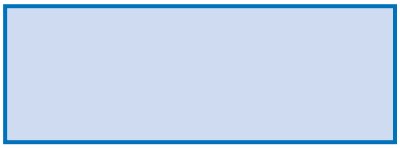
Tell your partner: I agree with you about . . . because . . .

Explore different ways to understand comparing quadrilaterals.

Is a square a rectangle?

Is a rectangle a square?

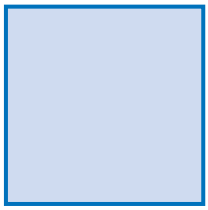




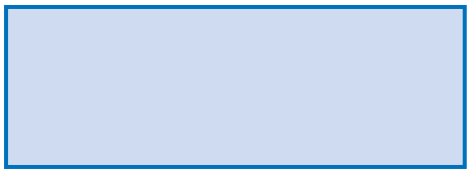
PICTURE IT

You can use a drawing to compare quadrilaterals.

All quadrilaterals have 4 sides and 4 angles.



4 right angles
2 pairs of parallel sides
4 sides the same length



4 right angles
2 pairs of parallel sides
2 pairs of opposite sides the same length

MODEL IT

You can use a table to compare quadrilaterals.

Shape	4 sides 4 angles	4 right angles	2 pairs of parallel sides	2 pairs of opposite sides that are the same length	4 sides that are the same length
Square	✓	✓	✓	✓	✓
Rectangle	✓	✓	✓	✓	sometimes

CONNECT IT

Now you will use the problem from the previous page to help you understand how to compare quadrilaterals.

1. What is an attribute of a square that is not an attribute of every rectangle?

2. Does every rectangle have all the attributes of a square?

3. Does every square have all the attributes of a rectangle?

4. Is every square a rectangle? Explain why or why not.

5. Is every rectangle a square? Explain why or why not.

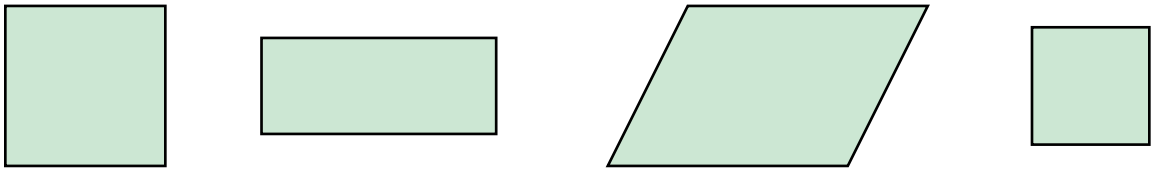
6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for comparing quadrilaterals? Explain.

APPLY IT

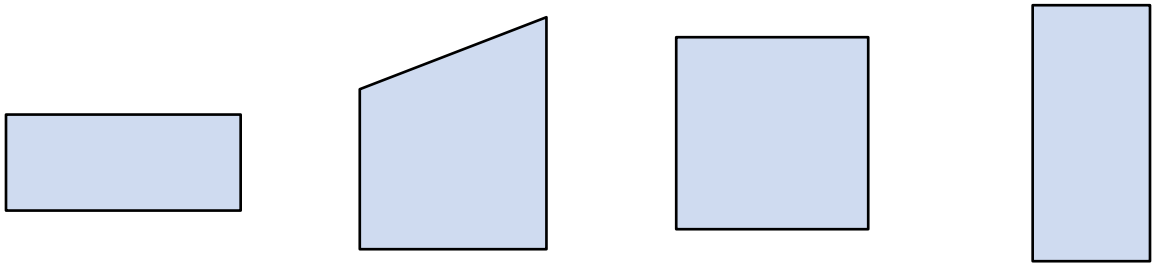
Use what you just learned to solve these problems.

7 Circle all the quadrilaterals below that are squares.



8 One way to define a trapezoid is a quadrilateral with exactly one pair of parallel sides. Draw a trapezoid with two right angles.

9 Circle all the quadrilaterals below that are rectangles.



Practice Comparing Quadrilaterals

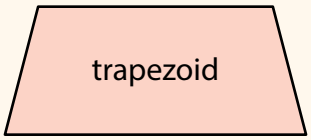
Study the Example showing how to compare quadrilaterals. Then solve problems 1–7.

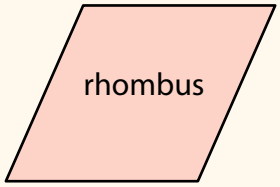
EXAMPLE

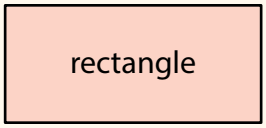
Which of these shapes are parallelograms?

You can list the attributes of a parallelogram in a table. Check if each shape always has these attributes.

Attribute	Trapezoid	Rhombus	Rectangle
4 sides	yes	yes	yes
4 angles	yes	yes	yes
2 pairs of parallel sides	no	yes	yes
2 pairs of sides that are the same length	no	yes	yes

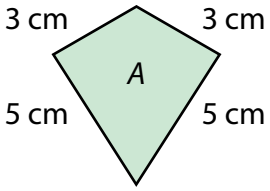






A rhombus and a rectangle have all the attributes of a parallelogram.

1 Is shape *A* a parallelogram? Explain.



2 What is another kind of quadrilateral that is also a parallelogram? Explain.

3 Fill in the blanks. Use information from the table above.

Every _____ is a parallelogram.

Every _____ is a parallelogram.

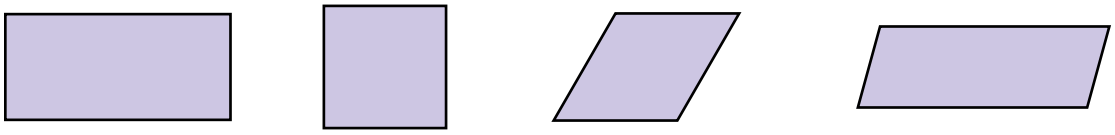
Vocabulary

attribute a way to describe a shape, like number of sides or length of sides.

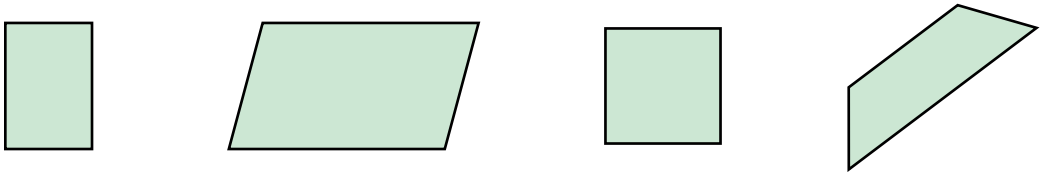
Use the table to solve problems 4–7.

Attribute	Parallelogram	Rhombus	Rectangle	Square
4 sides and 4 angles	yes	yes	yes	yes
4 right angles	sometimes	sometimes	yes	yes
2 pairs of parallel sides	yes	yes	yes	yes
2 pairs of sides that are the same length	yes	yes	yes	yes

4 Circle all the quadrilaterals that are rhombuses.



5 Circle all the quadrilaterals that are rectangles.



6 Tell whether each sentence is *True* or *False*.

	True	False
All squares are rectangles.	Ⓐ	Ⓑ
All rectangles are parallelograms.	Ⓒ	Ⓓ
All parallelograms are rectangles.	Ⓔ	Ⓕ
All quadrilaterals are parallelograms.	Ⓖ	Ⓗ
All parallelograms are quadrilaterals.	Ⓘ	Ⓙ

7 Jaime says that some rectangles are not squares. Do you agree? Explain.

Develop Naming and Drawing Quadrilaterals

Read and try to solve the problem below.

I have a quadrilateral. It has 4 sides that are all the same length. It does not have any right angles. What is the name of my shape?

TRY IT

Math Toolkit

- geoboards
- rubber bands
- rulers
- grid paper
- dot paper
- toothpicks

DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I agree with you about . . . because . . .

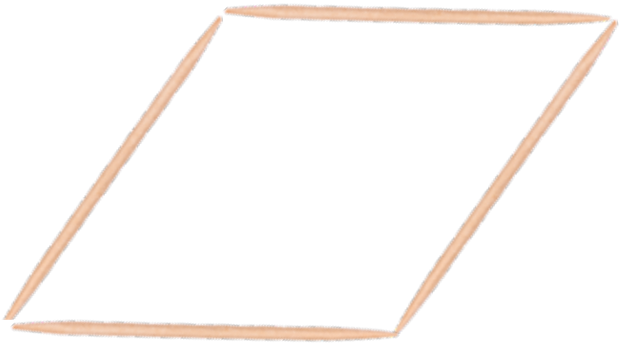
Explore different ways to understand naming and drawing quadrilaterals.

I have a quadrilateral. It has 4 sides that are all the same length. It does not have any right angles. What is the name of my shape?

MODEL IT

You can make a model to help name a quadrilateral.

Choose 4 toothpicks all the same length. Arrange them to look like a quadrilateral. Make sure there are no right angles.



It does not have any right angles, so it is not a square.

SOLVE IT

You can make a list of the attributes to help you name a quadrilateral.

Look at the model above. Think about everything you know about this shape.

- It is a quadrilateral, so it has 4 sides and 4 angles.
- It has 4 sides that are all the same length.
- It does not have any right angles, so it is not a square.

Using the list of attributes, you can name the shape.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to name and draw quadrilaterals by looking at their attributes.

1. What is the name of the shape described on the previous page? How do you know?

2. Look at the shape to the right. Is it a quadrilateral? Explain why or why not.

3. Is the shape a parallelogram? Is it a rectangle? Is it a rhombus? Explain.

4. Draw a different quadrilateral that is NOT a parallelogram, a rectangle, or a rhombus.

5 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model It** and **Solve It**. Which models or strategies do you like best for naming and drawing quadrilaterals? Explain.

APPLY IT

Use what you just learned to solve these problems.

6 Circle all the quadrilaterals below that have 2 pairs of sides the same length, but are not rectangles.

7 Draw a quadrilateral that has at least 1 right angle, but is not a rectangle.

8 Draw a quadrilateral in which all sides are not the same length, opposite sides are the same length, and there are no right angles. Then name the quadrilateral.

Solution

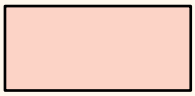
Practice Naming and Drawing Quadrilaterals

Study the Example showing how to name a quadrilateral.
Then solve problems 1–9.

EXAMPLE

Justin is drawing a quadrilateral with opposite sides that are the same length. All 4 sides are not the same length. What quadrilaterals can Justin draw?

Make a drawing to see what the quadrilaterals might look like.

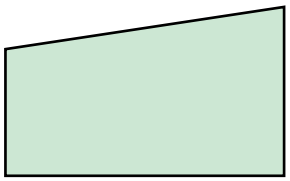


Opposite sides are the same length.
The shape has 4 right angles.

Opposite sides are the same length.
The shape has no right angles.

Justin can draw a rectangle or a parallelogram.

Use the shape on the right to answer problems 1–5.



1. One wall of a shed looks like the shape on the right. How many sides and angles does the shape have?

2. How many parallel sides does the shape have?

3. How many right angles does the shape have?

4. Does the shape have 2 pairs of sides the same length?

5. Circle all the words you can use to name this shape.

   quadrilateral parallelogram rectangle

Use the clues and shapes *A*–*E* to solve problems 6–8.

6 I have 4 sides. I am a parallelogram.
I have all right angles.
I am not a square.

I am shape _____.

I am a _____.

7 I am a quadrilateral.
I do not have any right angles.
My sides are all the same length.

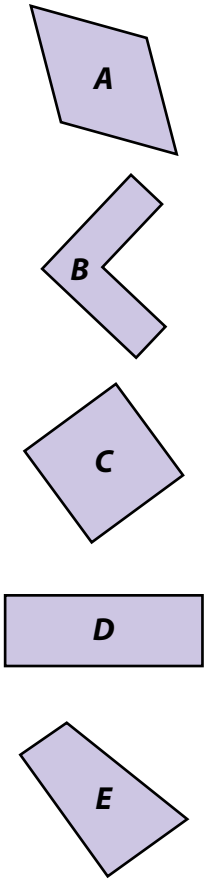
I am shape _____.

I am a _____.

8 I have more than 1 right angle.
Some of my sides are the same length.
I am not a quadrilateral.

I am shape _____.

I am a _____.



9 Draw a quadrilateral that has at least 3 right angles, 2 pairs of parallel sides, and all sides the same length. Write all of the possible names for your shape. Tell why the names fit.

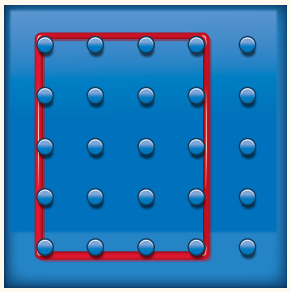
Refine Classifying Quadrilaterals

Complete the Example below. Then solve problems 1–9.

EXAMPLE

A patio has 2 pairs of sides that are the same length. All sides are not the same length, but it does have 4 right angles. What shape is the patio?

Look at how you could show your work using a model.



Solution

The student used a geoboard to model the shape. Now you can see what the shape looks like.

PAIR/SHARE
How else could you model the shape?

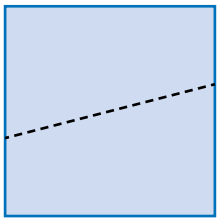
APPLY IT

1 Draw a quadrilateral that has no sides the same length and no right angles. Show your work.

The shape you draw will not be a rectangle or a square. It will not be a parallelogram or a rhombus.

PAIR/SHARE
What is a different shape you can draw to solve the problem?

2 Friona cut along the dashed line shown on the shape below. She knows that she made two quadrilaterals.



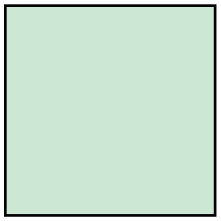
Is either of Friona's quadrilaterals a parallelogram? Explain why or why not.

Solution

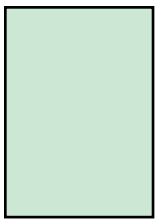
It may help to list the attributes of a parallelogram.

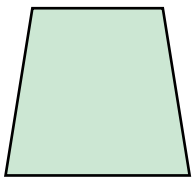
PAIR/SHARE
List the attributes of each of Friona's quadrilaterals.

3 Which shape is NOT a rectangle?

Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

What are the attributes of each shape?

Ari chose Ⓐ as the correct answer. How did he get that answer?

PAIR/SHARE
What are four ways to name the shape Ari chose?

4 A rhombus must have all of these attributes except which one?

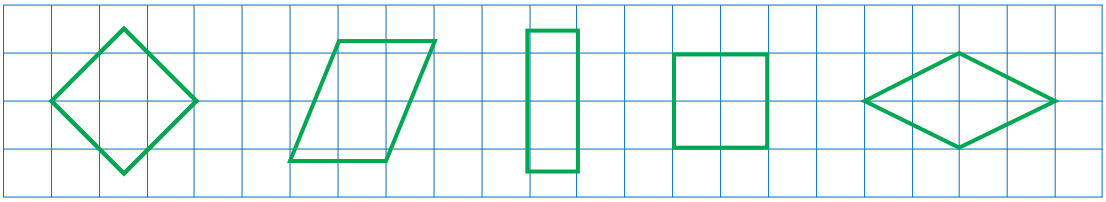
Ⓐ 4 sides that are the same length

Ⓑ 2 pairs of parallel sides

Ⓒ 4 right angles

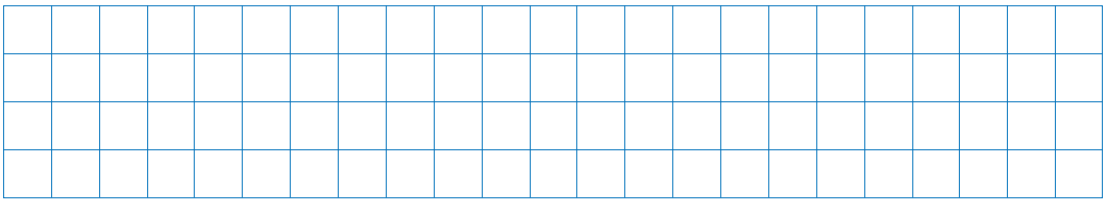
Ⓓ 4 sides and 4 angles

5 What is the best name that describes all the shapes below?



6 Use the grid below. Draw a quadrilateral that belongs to at least two of these groups: *parallelogram*, *rectangle*, or *square*. Explain why your shape belongs to these groups. Show your work.

7 Use the grid below. Draw a quadrilateral that does NOT belong to any of these groups: *parallelogram*, *rectangle*, or *square*. Explain why your shape does not belong to any of these groups. Show your work.



8 Tell whether each sentence is *True* or *False*.

	True	False
All rhombuses are quadrilaterals.	Ⓐ	Ⓑ
All rectangles are squares.	Ⓒ	Ⓓ
All parallelograms are rectangles.	Ⓔ	Ⓕ
All quadrilaterals are parallelograms.	Ⓖ	Ⓗ
All squares are rhombuses.	Ⓘ	Ⓙ

9 MATH JOURNAL

Jess says that a square cannot be a rectangle because a rectangle has 2 long sides and 2 short sides. Is he correct? Explain.

SELF CHECK Go back to the Unit 6 Opener and see what you can check off.

Explore Partitioning Shapes into Parts with Equal Areas

Learning Target

- Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.

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

You have learned about equivalent fractions, equal parts of shapes, and finding area. In this lesson you will learn how to break apart shapes into parts with equal area. Use what you know to try to solve the problem below.

Use different ways to break each square into two equal parts. Shade one part of each square. What unit fraction could you use to describe the shaded part? Explain how you know.

TRY IT

Math Toolkit

- unit tiles
- grid paper
- dot paper
- sticky notes
- fraction models

DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: The strategy I used to find the answer was . . .

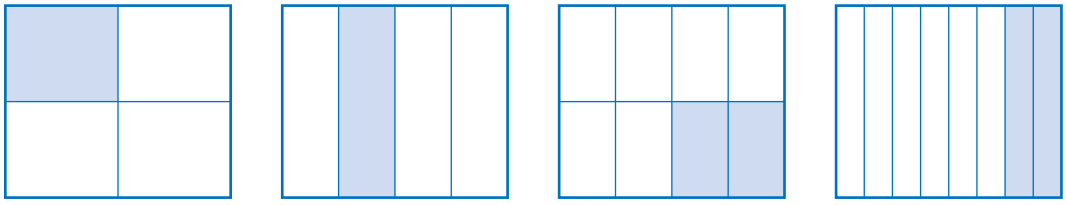
CONNECT IT

1 LOOK BACK

Explain how you know the unit fraction that names the shaded part of each square.

2 LOOK AHEAD

You can break apart the same shape into equal parts in a lot of ways. You can use fractions to describe the area that each part covers. Look at the rectangles below. The shaded areas of all four rectangles are both alike and different.



A *B* *C* *D*

a. What fraction of the area of rectangle *A* is shaded? .....

What fraction of the area of rectangle *B* is shaded? .....

What fraction of the area of rectangle *C* is shaded? .....

What fraction of the area of rectangle *D* is shaded? .....

b. For rectangles *C* and *D*, what unit fraction is equivalent to the fraction shown by the shaded parts? .....

3 REFLECT

What is the same about the areas shown by the shading in the four rectangles above? What is different?

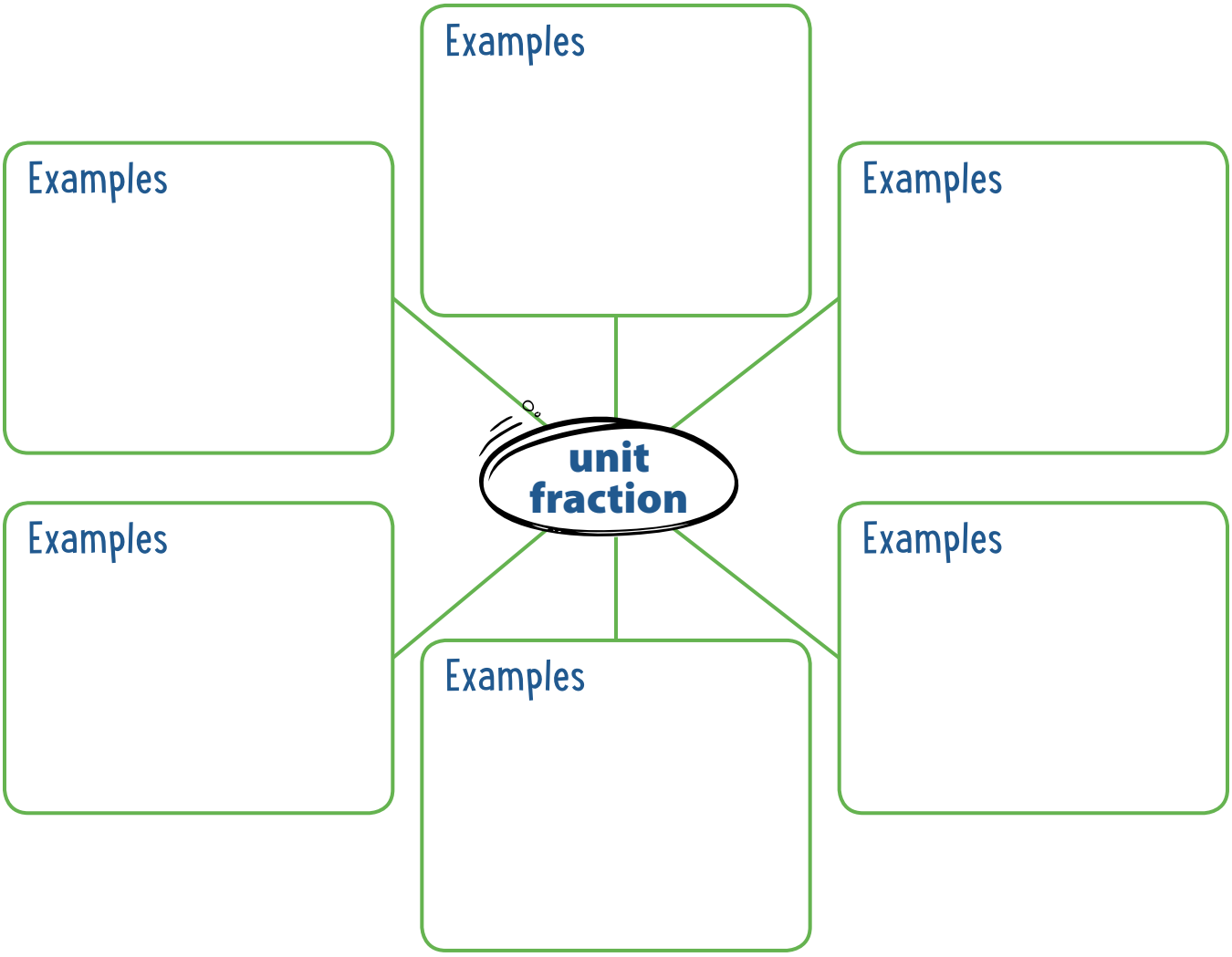
.....

.....

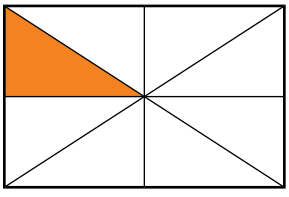
.....

Prepare for Partitioning Shapes into Parts with Equal Areas

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



2 Look at the rectangle below.



What unit fraction names the shaded part of the rectangle? .....

3 Solve the problem. Show your work.

Use different ways to break each square below into four equal parts. Shade one part of each square. What unit fraction could you use to describe the shaded part? Explain how you know.

Solution

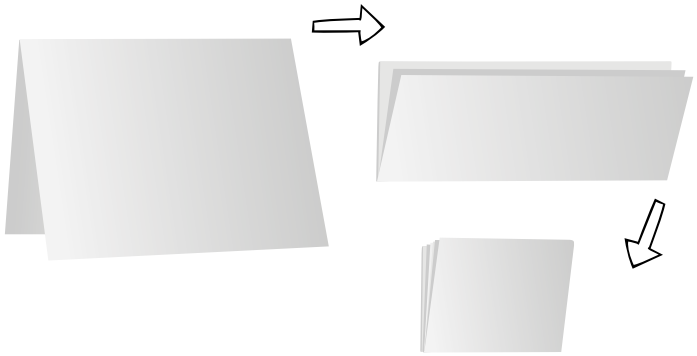
4 Check your answer. Show your work.

Develop Partitioning Shapes into Equal Parts

Read and try to solve the problem below.

Brett folded a piece of paper three times as shown. He then colored $\frac{1}{4}$ of the total area of the paper red. How could he have colored his paper?

Explain how you know your way is right.



TRY IT

Math Toolkit

- fraction tiles
- grid paper
- colored pencils
- fraction models

DISCUSS IT

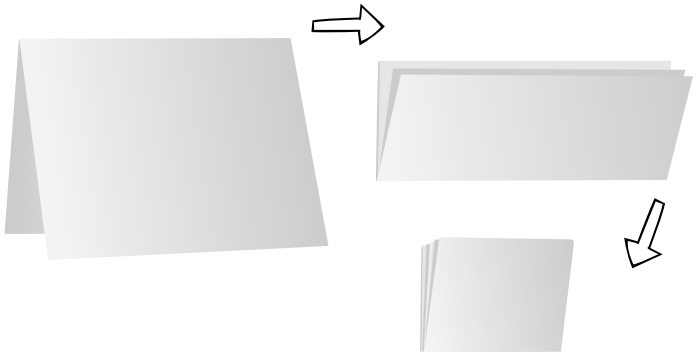
Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I agree with you about . . . because . . .

Explore different ways to understand dividing shapes into equal parts.

Brett folded a piece of paper three times as shown. He then colored $\frac{1}{4}$ of the total area of the paper red. How could he have colored his paper?

Explain how you know your way is right.



MODEL IT

You can act out the problem and make a model.

Fold a piece of paper in half three times as Brett did.

Unfold the paper.

This is what the paper looks like, divided into equal parts.

SOLVE IT

You can use equivalent fractions to solve the problem.

The paper has 8 equal parts.

You need to color a number of parts red so that $\frac{1}{4}$ of the area of the paper is colored.

Think of a fraction equivalent to $\frac{1}{4}$ to help solve the problem. You can compare numbers using $<$, $>$, or $=$. Since your fraction will be equivalent to $\frac{1}{4}$, you can compare the fractions using $=$.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to divide shapes into equal parts.

1 How many equal parts are on the paper? ..... How many in 1 row? .....

Suppose Brett colors 1 row. What fraction of the paper does he color? .....

What fraction of the paper is NOT colored? .....

Use $<$, $>$, or $=$ to compare the fraction of the paper that is colored and the fraction that is not colored. $\frac{2}{8}$ ◯ $\frac{6}{8}$

2 What fraction of the paper is 1 row? Explain.

3 Does Brett color $\frac{1}{4}$ of the area of the paper? Use your answers above to explain.

4 How else could Brett have colored $\frac{1}{4}$ of the paper?

5 To color $\frac{1}{4}$ of the paper, must Brett color parts that are next to each other? Explain.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model It** and **Solve It**. Which models or strategies do you like best for dividing shapes into equal parts? Explain.

.....

.....

.....

APPLY IT

Use what you just learned to solve these problems.

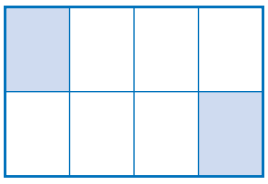
7 Divide this rectangle into 8 equal parts. What fraction of the total area of the rectangle is each part?

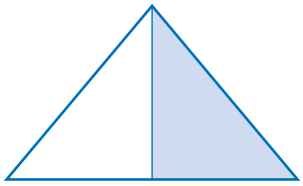
Solution

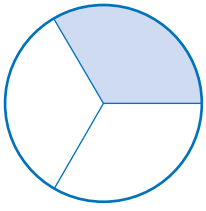
8 Show a different way to divide the rectangle from problem 7 into 8 equal parts. What fraction of the total area of the rectangle is each part?

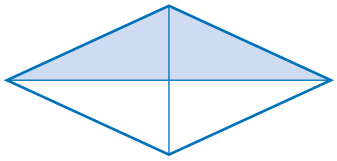
Solution

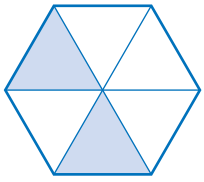
9 Each shape is divided into equal parts. Which shapes show $\frac{1}{2}$ of the area shaded?

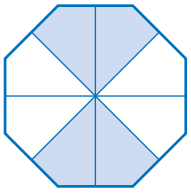
Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

Ⓔ 

Ⓕ 

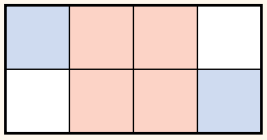
Practice Partitioning Shapes into Equal Parts

Study the Example showing how to divide rectangles into equal parts. Then solve problems 1–10.

EXAMPLE

Brad and Linda each cover a same-sized board with mosaic tiles. Here are the designs they made. What part of Brad's design is red tiles? What part of Linda's design is red tiles?

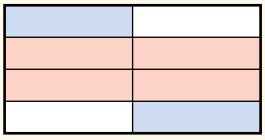
Brad's Design



2 rows of 4 tiles = 8 tiles

$\frac{4}{8}$, or $\frac{1}{2}$, of the tiles are red.

Linda's Design

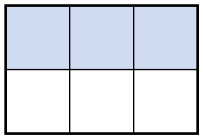


4 rows of 2 tiles = 8 tiles

$\frac{4}{8}$, or $\frac{1}{2}$, of the tiles are red.

1 How many equal parts are in rectangle *A*? .....

A



2 How many rows are in rectangle *A*? .....

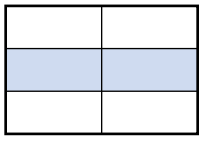
3 What fraction of the total area of rectangle *A* is shaded? .....

4 Use rectangle *B* to show another way to divide a rectangle into 6 equal parts. What unit fraction is each part? .....

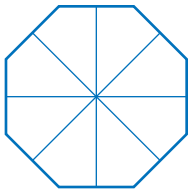
B

5 What fraction of the total area of rectangle *C* is shaded? Tell how you know.

C



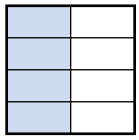
6 The octagon is divided into equal parts. What fraction of the total area of the octagon is each part? .....



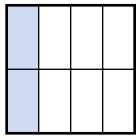
7 Compare squares *X* and *Y*. Tell whether each statement is *True* or *False*.

	True	False
$\frac{1}{2}$ of shape *X* is shaded.	Ⓐ	Ⓑ
$\frac{1}{2}$ of shape *Y* is shaded.	Ⓒ	Ⓓ
Each row of shape *X* is $\frac{1}{4}$ of the whole square.	Ⓔ	Ⓕ
Each row of shape *Y* is $\frac{1}{4}$ the whole square.	Ⓖ	Ⓗ

X



Y



8 Divide rectangle *S* into 4 equal parts and divide rectangle *T* into 8 equal parts.

S

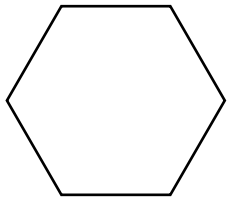
T

9 Shade $\frac{1}{4}$ of the area of each rectangle in problem 8.

10 Use $<$, $>$, or $=$ to compare the shaded parts of the rectangles in problem 8.

$\frac{1}{4}$ ○ .....

11 Divide the hexagon into 6 equal triangles. Then shade $\frac{1}{2}$ or $\frac{1}{3}$ of the area of the hexagon. Tell how you know $\frac{1}{2}$ or $\frac{1}{3}$ of the area is shaded.



Refine Partitioning Shapes into Parts with Equal Areas

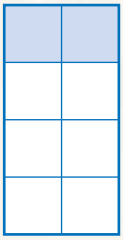
Complete the Example below. Then solve problems 1–8.

EXAMPLE

A rectangular game board is divided into same-sized squares. There are 4 rows. Each row has 2 squares. What fraction of the total area of the game board does each row cover?

Look at how you could show your work using a model.

1 row out of 4 rows is shaded.



Solution

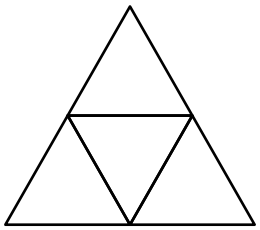
The student used a grid to make a model of the game board.

PAIR/SHARE

How could you solve the problem without using a model?

APPLY IT

1 The triangle is divided into equal parts. How does the area of one part compare to the area of the whole triangle? Shade $\frac{1}{2}$ of the triangle.



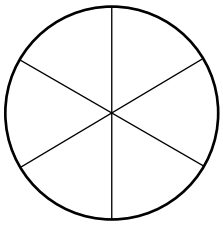
How many smaller triangles are there?

Solution

PAIR/SHARE

What is a different way to shade $\frac{1}{2}$ of the triangle?

2 Shade $\frac{1}{3}$ of the circle below. How many same-sized parts cover $\frac{1}{3}$ of the circle? Show your work.



Remember that $\frac{1}{3}$ means 1 out of 3 equal parts.

PAIR/SHARE

What fraction of the whole circle is each part?

Solution

3 A rectangle is equally divided into 2 rows. Each row is divided into 3 same-sized squares. What fraction of the total area of the rectangle is each square?

Ⓐ $\frac{1}{2}$

Ⓑ $\frac{1}{3}$

Ⓒ $\frac{1}{4}$

Ⓓ $\frac{1}{6}$

How many squares are in the whole rectangle?

Ben chose Ⓐ as the correct answer. How did he get that answer?

PAIR/SHARE

What do you think Ben was thinking when he chose his answer?

4 A rectangle is divided into same-sized squares. Four of the squares are shaded. The area of the shaded parts is $\frac{1}{2}$ the area of the whole rectangle. How many squares make up the whole rectangle?

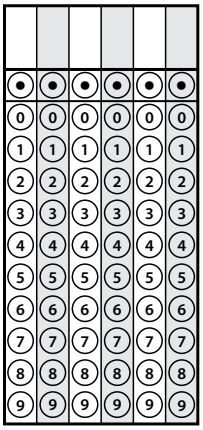
Ⓐ 2 squares

Ⓑ 4 squares

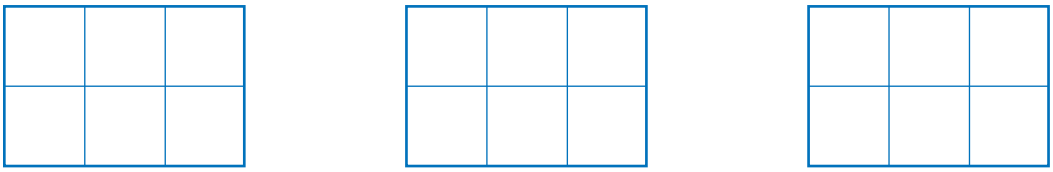
Ⓒ 8 squares

Ⓓ 16 squares

5 A rectangle is divided into 6 same-sized squares. How many squares cover $\frac{1}{2}$ of the area of the rectangle?



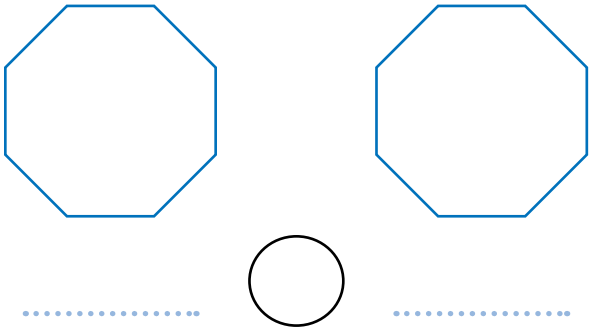
6 The rectangles below are all the same size. Dani wants to shade $\frac{1}{3}$ of the area of each rectangle. Use the rectangles below to show three different ways to shade $\frac{1}{3}$.



How many squares do you need to shade to cover $\frac{1}{3}$ of the area of one of the rectangles?

..... squares

7 Divide each octagon into 4 equal parts. Then shade one or more parts of each to show two different unit fractions. Write the fraction under each octagon. Then compare the fractions using <, >, or =.



8 MATH JOURNAL

Suppose you divide a hexagon into 6 equal parts. Explain how you could shade the parts to show three different unit fractions.

SELF CHECK Go back to the Unit 6 Opener and see what you can check off.