

Geometry

Students in third grade describe, analyze, and compare properties of two-dimensional shapes. They compare and classify shapes by their sides and angles, and they use these classifications to define shapes. Students also relate their fraction work to geometry by expressing the area of part of a shape as a unit fraction of the whole.

More specifically, students understand that shapes in different categories may share attributes. They explore properties of shapes to understand that shared attributes can define a larger category. For example, students realize that rhombuses, squares, and rectangles have four sides and that they are all quadrilaterals, and students can identify other examples of quadrilaterals that do not belong to this category. They conceptualize that a quadrilateral must be a closed figure with four straight sides and begin to notice characteristics of angles and relationships between opposite sides.

Students also partition shapes into parts with equal areas. They express the area of the whole. This builds on students' work with fractions and area. Students are responsible for partitioning shapes into halves, thirds, fourths, sixths, and eighths. For example, given a shape, students partition it into equal parts and recognize that the parts all have the same area. They identify the fraction name of each part and are able to partition a shape into parts with equal areas in several different ways.

The Grade 3 Common Core State Standards for Geometry specify that students should—

- Reason with shapes and their attributes.

The following hands-on activities will help students understand the attributes of shapes. The activities will equip students with the experiences necessary to identify squares, rectangles, and rhombuses as quadrilaterals. They should be encouraged to provide details when describing the properties of quadrilaterals. Mathematically proficient third graders use clear and precise language in their discussions with others and in their own reasoning.

Geometry

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Objective

Categorize shapes.

Common Core State Standards

- **3.G.1** Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

Geometry**Categorizing Shapes**

The reasoning skills that students have developed at this age allow them to explore and solve more complex geometric problems. They become more precise as they describe and classify shapes. As they compare shapes, they explain and justify their reasoning. In this lesson, students use Pattern Blocks to model and create new shapes with various attributes.

Try It! Perform the Try It! activity on the next page.

Talk About It

Discuss the Try It! activity.

- **Ask:** *Can Sasha have a triangle as her new shape? Why or why not?* Guide discussion around quadrilaterals having 4 sides and triangles having 3 sides.
- **Ask:** *Can Sasha make a pentagon as her new shape? Why or why not?* Again, guide discussion that pentagons have 5 sides, not 4 sides.
- **Ask:** *Could Sasha create a shape that has 4 sides that are all unequal lengths? Why or why not?* Guide students to conclude that a quadrilateral just needs 4 sides, no matter their lengths.

Solve It

Reread the problem with students. Have them draw their new shape to share with the class. Then, have them write a few sentences explaining why their shape is a quadrilateral and how it is different from the three quadrilaterals that Sasha already made.

More Ideas

For other ways to teach about categorizing shapes—

- Have pairs use Pattern Blocks and a spinner numbered 3, 4, 5, 6, and 8. Have one student spin the spinner. Then have the students create several shapes with that number of sides. Have students describe and compare their shapes and categorize them if possible.
- Have pairs take a handful of Pattern Blocks. Ask students to sort the shapes they chose into groups that share the same characteristics. Have students explain their groupings, focusing on number of sides, number of corners, comparisons between angles, etc.

Formative Assessment

Have students try the following problem.

Which shape is not a quadrilateral?

- A. square B. rectangle C. triangle D. rhombus

Try It! 20 minutes | Pairs

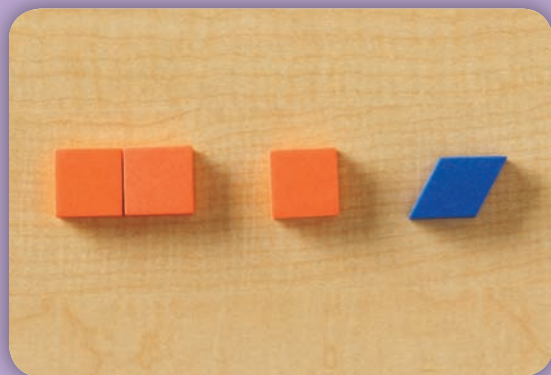
Here is a problem about categorizing shapes.

Sasha has been making quadrilaterals and she wants to make a new one. So far, she has made a rectangle, square, and rhombus. Help Sasha find a quadrilateral she has not yet made. Compare the properties of the new quadrilateral with the properties of the ones she has already made.

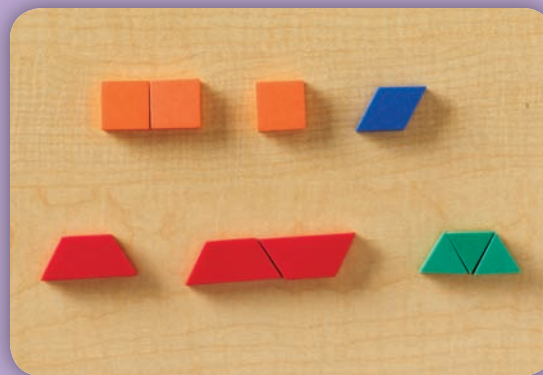
Introduce the problem. Then have students do the activity to solve the problem. Distribute Pattern Blocks to students.

Materials

- Pattern Blocks (10 triangles and 7 each of the other shapes per pair)



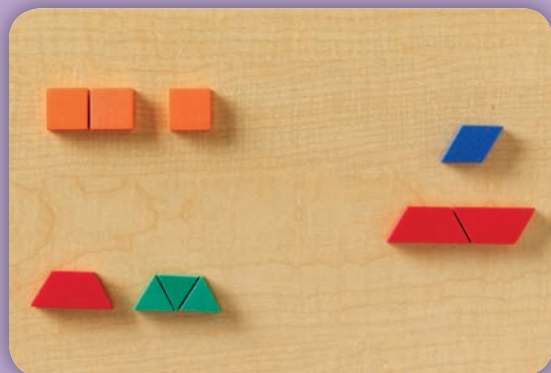
1. Say: Find or make each of the shapes Sasha has already made. Have students find or make a rectangle, square, and rhombus using Pattern Blocks. **Ask:** What property do all these shapes have that make them a quadrilateral? Elicit that they all have 4 sides.



2. Ask: What other properties do the shapes have? Guide discussion to squares having square corners (right angles) and 4 sides the same length, rectangles having square corners and opposite sides the same length, and rhombuses having 4 equal sides, but not necessarily square corners. **Say:** Sasha wants to make a new quadrilateral. Find or make some shapes that could be Sasha's.

! Look Out!

Watch for students who are counting all the sides of the smaller blocks, and not the "big picture" sides once a new shape is created. Have students trace around their new shape to see the real sides of the new shape.

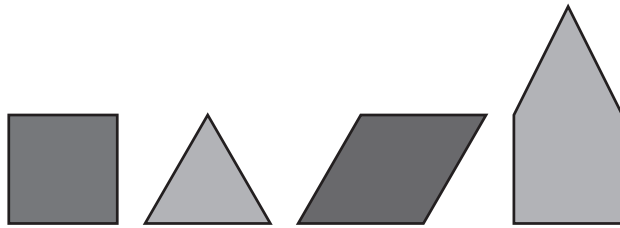


3. Say: Look at all your shapes. Compare their properties. Have students look for common attributes among their shapes (beyond having 4 sides) and group the shapes according to these attributes. Discuss the attributes with students.



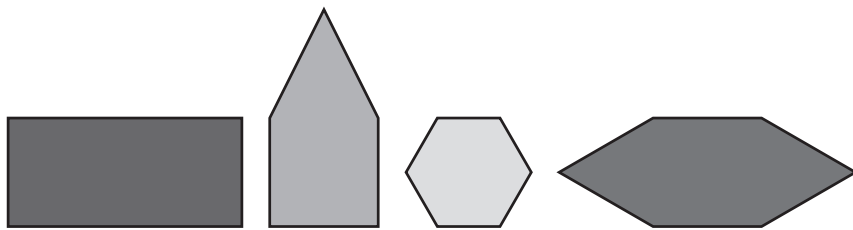
Use Pattern Blocks to model the shapes. (Check students' work.)

1. Circle 2 quadrilaterals.



square and rhombus circled

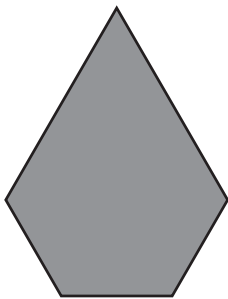
2. Circle 2 hexagons.



last two shapes circled

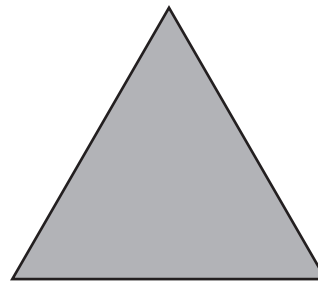
Model the shape. Draw or trace a shape that has at least one same property. (Check students' models.)

3.



any shape that has 5 sides

4.



this can be any kind of triangle

Use Pattern Blocks to model and trace the shapes described.

5. 4 different quadrilaterals

Possible answers: square, rectangle, rhombus, trapezoid, parallelogram

Answer Key

Challenge! Jessica says that all rhombuses are quadrilaterals. Mike says all quadrilaterals are rhombuses. Who is right? Explain your answer using words and drawings.

Challenges: Jessica is right. All rhombuses are quadrilaterals with 4 sides and opposite sides parallel. There are more kinds of quadrilaterals than rhombuses, so all quadrilaterals cannot be rhombuses. Students may make drawings of squares or rectangles or trapezoids to show other quadrilaterals.

Objective

Partition shapes into equal areas.

Common Core State Standards

- **3.G.2** Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as $\frac{1}{4}$ of the area of the shape.*

Geometry

Partitioning Shapes

In this lesson, students build upon their understanding of fractions and area. Using concrete models, students are able to visualize how smaller shapes fill the area of larger shapes. They count to figure out how many equal pieces there are in each whole and determine the fraction for one equal piece in relation to the whole. Students use Pattern Blocks to partition shapes into smaller shapes and discover the fractional pieces.

Try It! Perform the Try It! activity on the next page.

Talk About It

Discuss the Try It! activity.

- **Say:** We can say that one triangle represents $\frac{1}{3}$ of the area of the trapezoid.
- **Ask:** What fraction of the area is represented by two triangle pieces?
- **Ask:** What fraction of the area is represented by three triangle pieces? Elicit that the fraction is $\frac{3}{3}$. Elicit further that three thirds is all the thirds, so $\frac{3}{3}$ refers to the whole area. Tell students that $\frac{3}{3}$ means the same thing as 1.

Solve It

Reread the problem with students. Have them write the denominator of the fraction (3 parts) and then the numerator, showing how many parts each triangle represents.

More Ideas

For other ways to teach about partitioning shapes into equal areas—

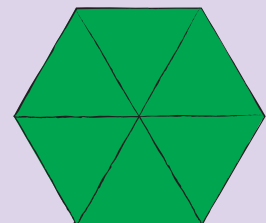
- Have students use Pattern Blocks to explore questions such as how many triangles make up a hexagon, how many rhombuses make up a hexagon, and so on. Have them trace the partitioned shape, and write a fraction representing one piece of the partitioned shape.
- Have students use Color Tiles to create partitioned rectangles and squares. Have them create partitions of halves, thirds, fourths, sixths, and eighths. Have them write the total number of partitions and the fraction that each partition represents.

Formative Assessment

Have students try the following problem.

What fraction of the hexagon is one green triangle?

- A. $\frac{1}{3}$ B. $\frac{1}{4}$ C. $\frac{1}{5}$ D. $\frac{1}{6}$



Try It! 25 minutes | Pairs

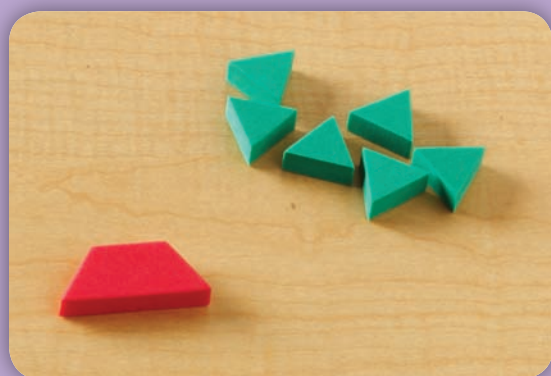
Here is a problem about partitioning shapes into equal areas.

Kyle is working with Pattern Blocks. He has divided a trapezoid block into equal triangles. How many triangles did he use? What fraction of the trapezoid does one triangle represent?

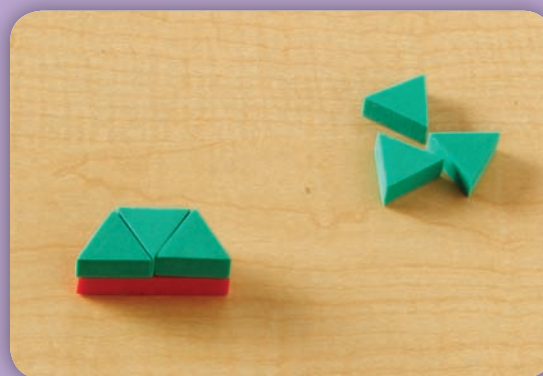
Introduce the problem. Then have students do the activity to solve the problem. Distribute Pattern Blocks, paper, and pencils to students.

Materials

- Pattern Blocks (10 triangles and 7 each of the other shapes per pair)
- paper (1 sheet per pair)
- pencils (1 per pair)



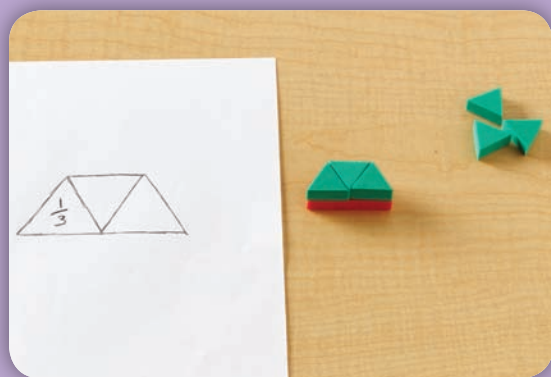
1. Say: Find the red trapezoid in your set of blocks. Find some green triangles. Let's see if we can put together some triangles to make a trapezoid.



2. Say: We are making the trapezoid with smaller equal pieces. So each equal piece will be a fraction of the whole shape. **Ask:** How many triangles are needed to make the trapezoid?

⚠ Look Out!

Watch for students who try to make the whole with different-sized shapes. Explain that the smaller shapes comprising the whole must all be the same size.

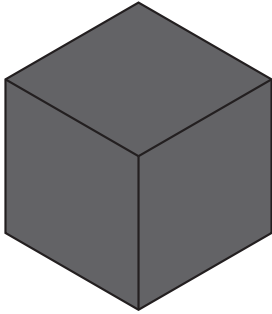


3. Ask: What fraction of the trapezoid does one triangle represent? **Say:** The total number of smaller parts is the denominator of the fraction. Write $\frac{1}{3}$ on the board. Elicit that since you asked what fraction of the whole one triangle represents, the numerator is 1. Complete the fraction on the board, $\frac{1}{3}$. Have students draw the model and label one of the thirds.

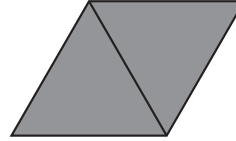


Use Pattern Blocks of equal size to divide the shape. Determine the number of equal pieces. Write the fraction for one piece. (Check students' work.)

1. yellow hexagon, divided using blue rhombuses

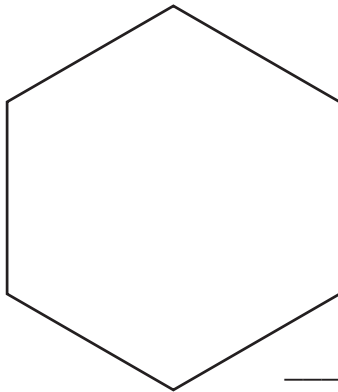

 $\frac{1}{3}$

2. blue rhombus, divided using green triangles

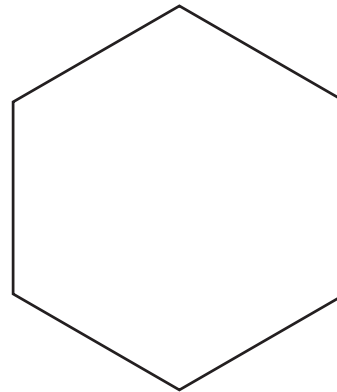

 $\frac{1}{2}$

Use Pattern Blocks of equal size to divide the shape. Draw the model. Write the fraction for one piece. (Check students' models.)

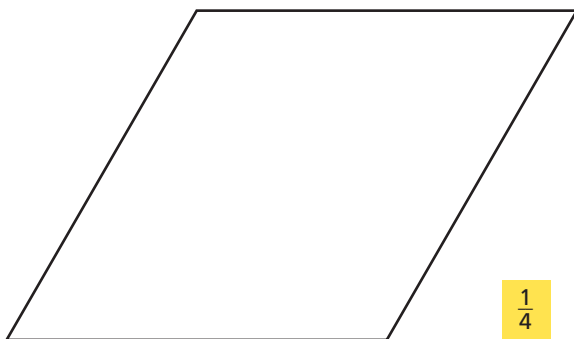
3. hexagon, divided using red trapezoids


 $\frac{1}{2}$

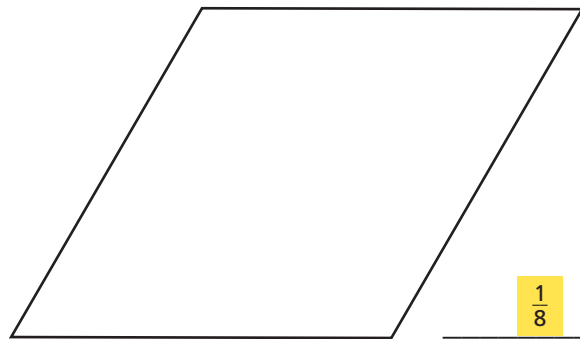
4. hexagon, divided using green triangles


 $\frac{1}{6}$

5. parallelogram, divided using blue rhombuses


 $\frac{1}{4}$

6. parallelogram, divided using green triangles


 $\frac{1}{8}$

Answer Key

Challenge! Explain why the smaller pieces you used in the previous problems must be of equal size to describe fractions of larger shapes.

Challenge: (Sample) Fractions are equal parts of a whole. To describe fractions of the larger shape, the smaller shapes must be equal.

LESSON
3

Objective

Partition shapes into equal areas.

Common Core State Standards

- **3.G.2** Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as $\frac{1}{4}$ of the area of the shape.*

Geometry

Partitioning More Shapes

In the previous lesson, students partitioned shapes into parts with equal areas using Pattern Blocks. Now students will build on this understanding using the Geoboard. By using the Geoboard, students can create a different variety of shapes and partition those into equal areas and describe the area of each part as a unit fraction of the whole.

Try It! Perform the Try It! activity on the next page.

Talk About It

Discuss the Try It! activity.

- **Ask:** *Why couldn't Elana's shape be a trapezoid?* Guide discussion to cover the need for a shape with square corners (right angles.) **Ask:** *Why couldn't Elana's shape be a square?* Discuss that on a Geoboard a square can be made of 1, 4, 9, or 16 equal squares, not 8.
- **Ask:** *What quadrilateral is made of 8 equal squares on a Geoboard?* Discuss that Elana's shape is a rectangle, because a rectangle can be made with 2 rows of 4, or 4 rows of 2.

Solve It

With students, reread the problem. Have them draw Elana's shape on Inch Grid Paper (BLM 8) and shade $\frac{1}{8}$ of it. Have them write two sentences describing their shape and telling why it matches Elana's description of her shape.

More Ideas

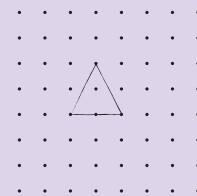
For other ways to teach about partitioning shapes into equal areas—

- Have students make a large rectangle on the Geoboard. Have them partition the rectangle into smaller equal sections as many ways as they can and record each of the ways on grid paper. For each way, have students count the number of smaller equal sections and write the fraction for one piece.
- Have one student create a shape on the Geoboard and give it to a partner. Then have the partner partition the shape into smaller equal parts. Have students describe their shape, the number of equal parts in it, and how one fractional piece would be represented.

Formative Assessment

Have students try the following problem.

If the following is $\frac{1}{6}$, what is the whole?



A.

B.

C.

D.

Try It! 25 minutes | Pairs

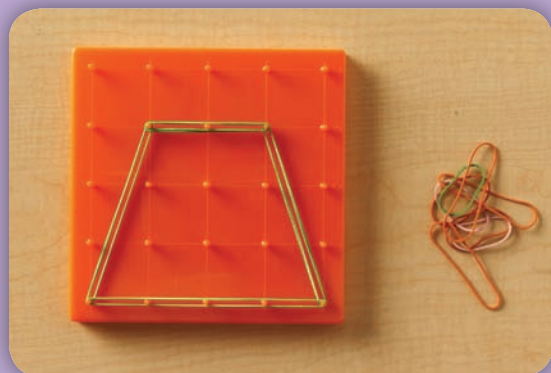
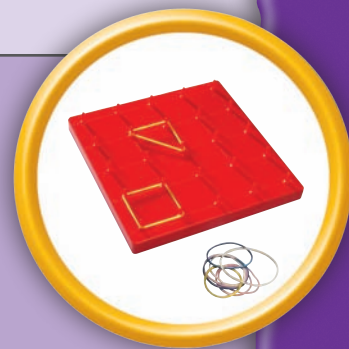
Here is a problem about partitioning shapes into equal areas.

Elana created a shape on her Geoboard. She described it as a quadrilateral and said that $\frac{1}{8}$ of it was a square. What shape did she make?

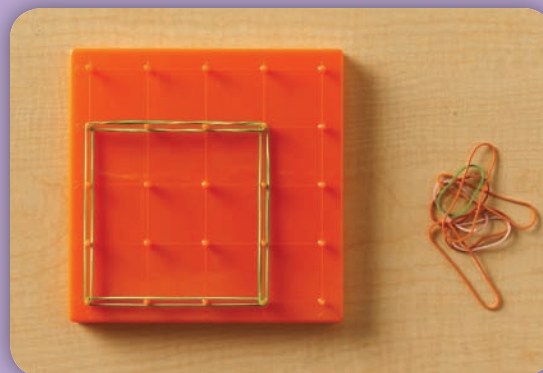
Introduce the problem. Then have students do the activity to solve the problem. Distribute Geoboards, Inch Grid Paper (BLM 8), and pencils to students.

Materials

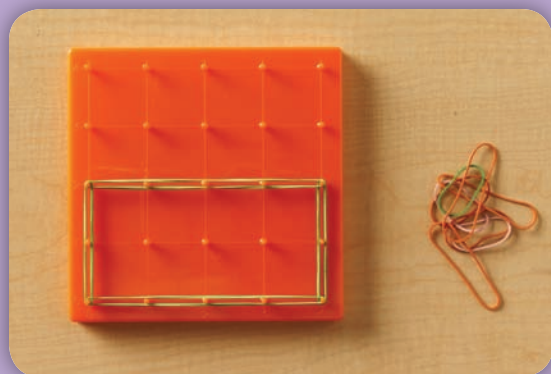
- Geoboard (1 per pair)
- Inch Grid Paper (BLM 8; 1 per student)
- pencils (1 per student)



1. Say: Elana says her shape is a quadrilateral. **Ask:** What does that tell us? What are some shapes that are quadrilaterals? List shapes on the board: square, rectangle, trapezoid, rhombus, etc. **Say:** Make a trapezoid on your Geoboard.



2. Say: Elana also said that $\frac{1}{8}$ of the shape is a square. **Ask:** How many squares is her shape divided into? Can you divide your trapezoid into 8 equal squares? Why not? Elicit that the shape must have square corners (right angles). **Say:** Make a square on your Geoboard.



3. Ask: How many smaller squares are in your square? Can you make a square with 8 equal square parts on your Geoboard? **Say:** Make a quadrilateral that you can divide into 8 equal square parts.

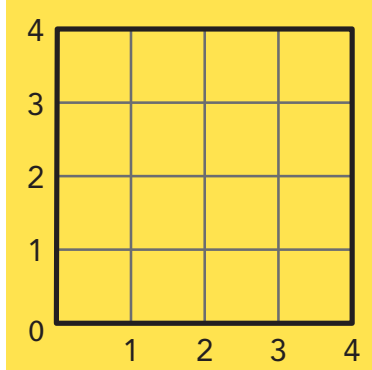
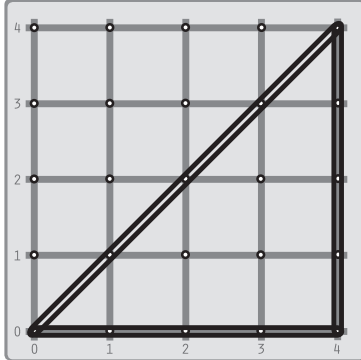
! Look Out!

Watch for students who do not partition the larger shape into equal smaller parts. Remind students that the smaller parts need to be the same size and shape, because fractional parts mean equal parts.

Use a Geoboard to model a whole shape using the part given.
 Draw the whole shape on the grid. (Check students' work.)

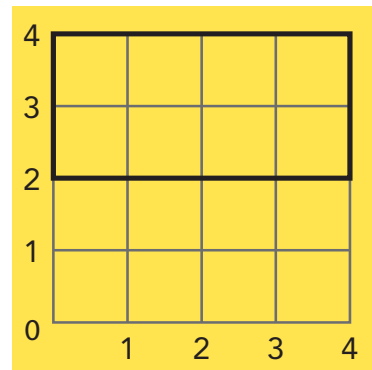
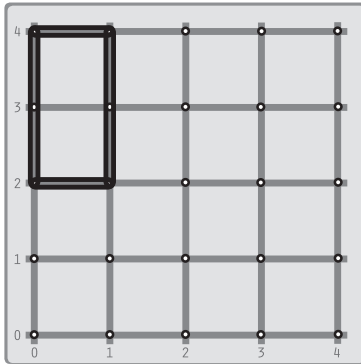
1. triangle = $\frac{1}{2}$ square

a 4 x 4 square made of 2 equal triangles



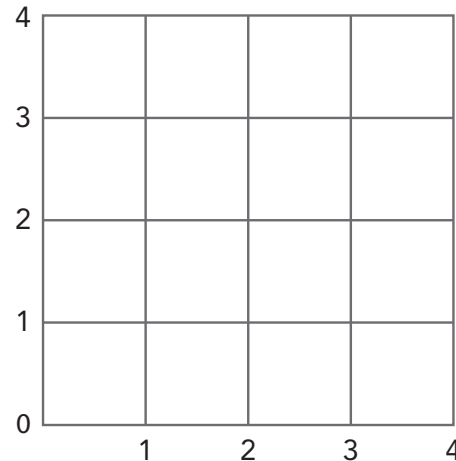
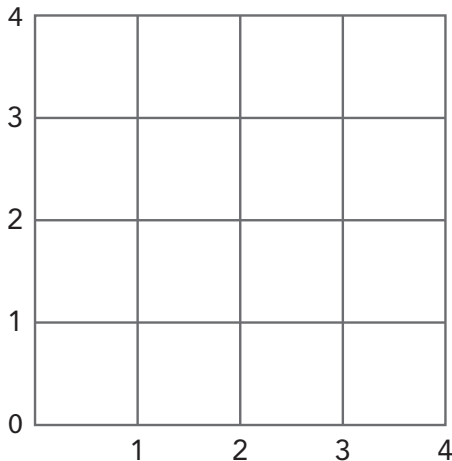
2. rectangle = $\frac{1}{4}$ rectangle

a 4 x 2 or 2 x 4 rectangle made of 4 equal rectangles



3. square = $\frac{1}{9}$ square

4. trapezoid = $\frac{1}{2}$ hexagon



a 3 x 3 square made of 9 equal squares

a hexagon made of 2 equal trapezoids

Answer Key

Challenge! Cheryl says she can make a pentagon on her Geoboard using 6 right triangles. Use your Geoboard to try this, and draw the shapes to show if Cheryl is correct. Describe your work.

Challenge: (Sample) A pentagon, or house, can be made using 2 right triangles as the roof, and then 4 alternating right triangles to make the bottom of the house.
