

# Geometry

**Geometry** in the elementary classroom means more than recalling the names of shapes, measuring angles, and making tessellations—it is closely linked to other mathematical concepts. For example, geometric representations can help children make sense of fractions and area.

Children will also understand how “parts” are related to “wholes” as they begin to partition regions into equal shares and use words like halves, fourths, and quarter of. Such understanding is an essential learning component for more in-depth studies of fractions in later elementary years.

Whether studying shapes and their attributes in the early years or working with geometric proofs in the secondary grades, geometry enables learners to interpret and describe their physical environment. It provides children opportunities to physically and mentally change the positions of objects, describe shapes and the relationships among them, and solve problems using special reasoning.

## The Grade 1 Common Core State Standards for Geometry specify that children should—

- Reason with shapes and their attributes.

The following hands-on activities enable teachers to help children learn the concepts of geometry in a rich and meaningful way. It is important that teachers and children “label” terms and use such terminology appropriately. Doing so will enable children to develop the precision necessary for recognizing and describing similarities and differences among shapes.

# Geometry

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## Objective

Combine geometric shapes to compose a copy of a given shape.

## Common Core State Standards

- **1.G.2** Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

## Geometry

## Combining Shapes

Giving children the opportunity to combine shapes helps them build important mathematical skills. In this activity, children will be placing shapes on top of other shapes. This will allow them a concrete exploration of how shapes can be combined to form new shapes. The hands-on approach to combining shapes will help children build congruence using the idea that the pieces coincide. This lesson also provides an introduction to tangrams. Familiarity with these shapes will help children work with puzzles in later activities.

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

## Talk About It

Discuss the Try It! activity.

- **Ask:** *What shapes did you use to cover the square? How many did you use? Was there more than one way to cover the square?*
- **Ask:** *What shapes did you use to cover the parallelogram? How many shapes did you use? Did you find more than one way to cover the parallelogram?*
- **Ask:** *What shapes did you use to cover the triangle? How many shapes did you use? Say: Describe the shapes you used for both ways you found to cover the triangle.*

## Solve It

With children, reread the problem. Have children experiment to find the answer (two triangles). Then have children draw a triangle made out of two smaller triangles and write a sentence telling what shapes Andrew used.

## More Ideas

For other ways to teach about combining shapes to copy other shapes—

- Distribute paper bags with Pattern Block squares and triangles to groups of three. Each child should reach into the bag and choose a shape without looking. The child then names the shape and builds it using two or more Tangram pieces. For children who need an additional challenge, introduce the trapezoid Pattern Block and ask them to build the shape with Tangram pieces.
- Have children work in pairs. Name a shape that can be built with Tangram pieces, such as a square, a triangle, or a parallelogram. Ask children to see if they can build the shapes using only triangles, or only squares and parallelograms. For an extra challenge, ask children if they can make a shape with five or six sides out of Tangram pieces.

## Formative Assessment

Have children try the following problem.

*Draw a line through this shape to make two triangles.*



## Try It! 20 minutes | Pairs

Here is a problem about combining shapes to compose copies of other shapes.

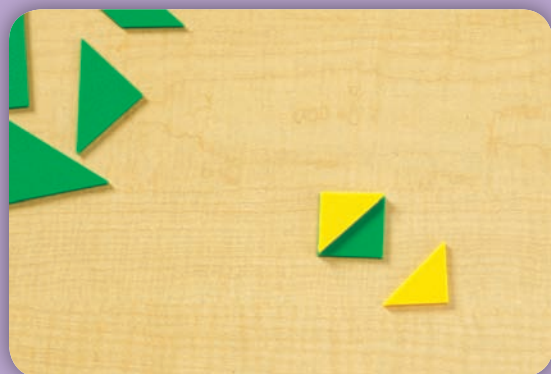
*Andrew's class is building shapes using Tangram pieces. Andrew chose two shapes. He used them to make a square. What two shapes did Andrew use?*

Introduce the problem. Then have children do the activity to solve the problem.

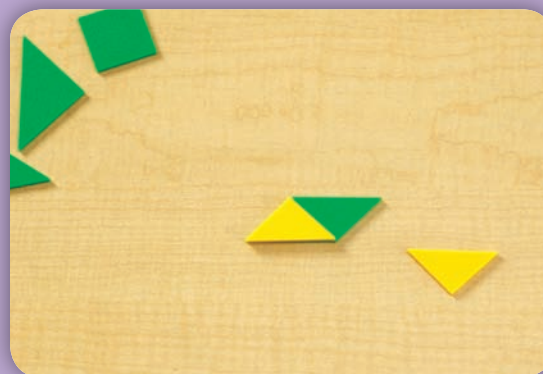
Draw a square, a triangle, and a parallelogram on the board. Tell children the name of each shape, and then have them practice saying the shape names. Distribute Tangrams to children.

### Materials

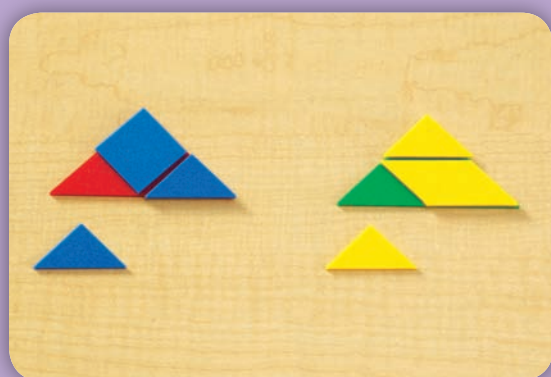
- Tangrams (2 sets per pair)



**1.** Instruct children to choose a square from their Tangrams. Ask children to use other shapes to cover the square.



**2.** Invite children to choose a parallelogram Tangram piece from the set. Instruct them to use other shapes to cover the surface of the parallelogram.



**3.** Have children repeat the activity by covering a large triangle with other Tangram pieces. Tell children that there is more than one way to do this. Ask them to find two different combinations of shapes that they can use.

### ! Look Out!

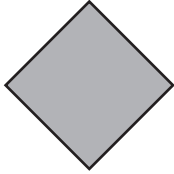
Children may be confused about the idea of covering up shapes. They may use Tangram pieces that do not fit exactly, causing the top shapes to overlap the bottom or leaving parts of the bottom shape uncovered. If this is the case, remind children that the pieces on top should make a shape that is exactly the same as the bottom shape.



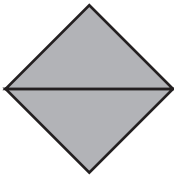


**Use Tangram pieces. Make each shape.**  
**Tell what pieces you used.** (Check students' work.)

1.



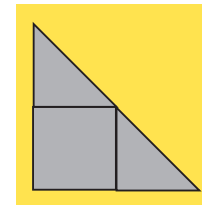
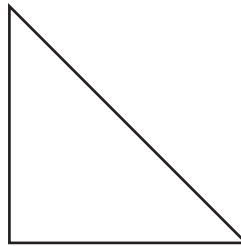
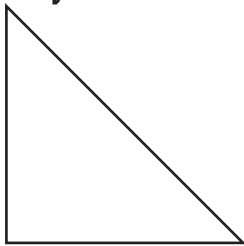
square



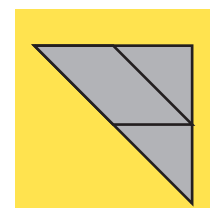
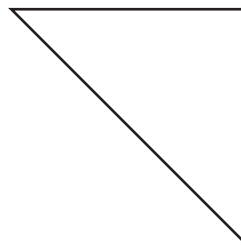
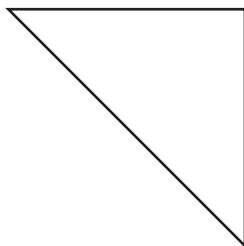
two small triangles

**Use Tangram pieces. Match the shape shown on the left using more than 1 piece. Draw the model in the shape on the right.**

2. square and 2 other pieces



3. parallelogram and 2 other pieces



## Answer Key

**Challenge!** How can you tell if two shapes are exactly the same size and shape?

Challenge: (Sample) Place them on top of each other and make sure all of their sides match up.

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## Objective

Explore ways of combining different shapes to compose new shapes.

## Common Core State Standards

- **1.G.2** Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

## Geometry

# Building Shapes

Giving children the opportunity to combine and take apart shapes helps them build several important mathematical skills. Such activities foster spatial reasoning and spatial visualization and deepen children's understanding of geometric properties. Open-ended activities like the one in this lesson encourage the development of problem-solving skills and logical thinking that will be applicable in a variety of experiences both in and out of the classroom environment.

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

## Talk About It

Discuss the Try It! activity.

- **Ask:** What shapes did you use to make a square? **Say:** Tell me something about your square.
- **Ask:** What shapes did you use to make the parallelogram? **Say:** Tell me something about your parallelogram.
- **Ask:** What shapes did you use to make the triangle? **Say:** Tell me something about your triangle.
- **Ask:** How is the triangle like the square you made? How is it different? How is the triangle like the parallelogram? How is it different? How are the parallelogram and the square alike? How are they different?

## Solve It

With children, reread the problem. Then have children draw one way to make each shape out of Tangram pieces.

## More Ideas

For other ways to teach about combining shapes to compose new shapes—

- Have children use Snap Cubes® to build composite shapes. Children can build cubes and prisms and combine them to build the composite shapes that you specify.
- Have children use Tangram pieces to play a guessing game. Ask them to build a rectangle. They then build the rectangle out of a square and two triangles or a parallelogram and two triangles. Ask them to build a parallelogram. They should then build a parallelogram out of a square and two triangles, or two triangles. Ask them to build a square. They can use two triangles.

## Formative Assessment

Have children try the following problem.

Divide this shape into six equal triangles and color each triangle a different color.



# Try It!

20 minutes | Pairs

Here is a problem about combining shapes to compose new shapes.

*Juan's class is building shapes using Tangram pieces. Juan's teacher asks him to build a square, a triangle, and a parallelogram. How can Juan build these shapes using Tangram pieces?*

Introduce the problem. Then have children do the activity to solve the problem.

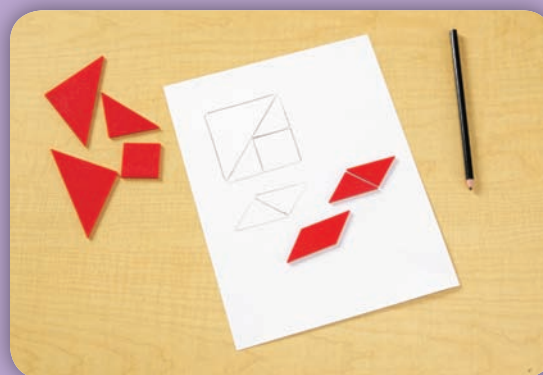
Draw a square, a triangle, and a parallelogram on the board. Review the shape names, giving special attention to the parallelogram, which may be unfamiliar to children. Distribute Tangrams, paper, and pencils to children.

## Materials

- Tangrams (1 set per pair)
- paper (1 sheet per child)
- pencils (1 per child)



**1.** Instruct children to use Tangram pieces to build a square. Have them trace the shapes onto paper to show how they made the square.



**2.** Instruct children to use Tangram pieces to build a parallelogram. Have children trace the shapes onto paper to show how they made the parallelogram.



**3.** Have children repeat the activity by making a triangle with the Tangram pieces and tracing the result. Have children share their observations about the new shapes, including similarities and differences between them, and where they can see these shapes in the classroom, playground, school, home, store, and so on.

## Look Out!

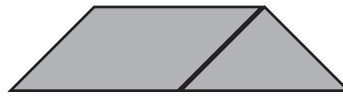
Children may have trouble seeing how Tangram pieces fit together to make other shapes. You may wish to help them by drawing on the board the shape you are asking them to build, then drawing a line to show the silhouette of one smaller shape within it. For example, if you are asking children to build a parallelogram, you may want to draw it on the board and then draw a line to show one of the triangles that it is made of. Then ask children if they can see another triangle in the parallelogram.



Use Tangram pieces to model the shape shown on the left. Name the pieces you used to make the shape.

(Check students' work.)

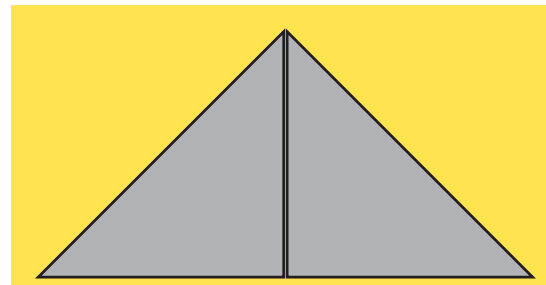
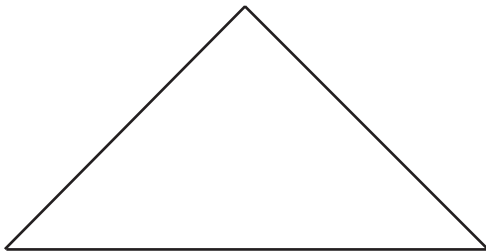
1.



parallelogram and small triangle

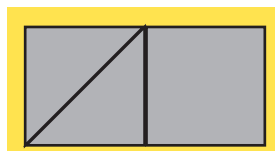
Use Tangram pieces. Make the shape shown on the left using more than 1 piece. Sketch the model in the shape on the right. Name the pieces used.

2.



two triangles

3.



two small triangles and square

## Answer Key

**Challenge!** When you join two Tangram shapes to make another shape, what parts of the shapes touch each other?

Challenge: The sides must line up/touch to form a straight line.

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## Objective

Use Tangrams to solve visual/spatial puzzles.

## Common Core State Standards

- **1.G.2** Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

## Geometry

## Tangram Puzzles

While young children are often able to recognize and label a variety of simple geometric shapes, they have not yet developed a solid understanding of geometric concepts. Having the opportunity to solve puzzles using shapes will build a solid understanding of the shapes and foster the spatial and problem-solving skills needed to comprehend more involved geometric skills.

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

## Talk About It

Discuss the Try It! activity.

- **Ask:** Which shapes were already filled in for you on the first Tangram puzzle?
- **Ask:** Which shapes did you use to complete the first puzzle? Invite volunteers to list the combinations of shapes that they used.
- **Ask:** Did anyone use different shapes to finish the first puzzle? Allow children to compare the shapes they used. Repeat questions for the second puzzle and have children compare their results.

## Solve It

With children, reread the problem. Then have children use the Tangram pieces to make their design. They can use any combination of Tangram pieces, as long as the end result is a square. Children will write to describe their designs and draw pictures of their designs on paper.

## More Ideas

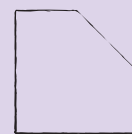
For other ways to teach about solving visual/spatial puzzles—

- Have children create their own puzzles by putting all 7 Tangram pieces together to make pictures of their choice. Then children will outline their pictures and trade with a partner. Each partner will attempt to fill in the other's puzzle.
- Distribute Tangrams to children and have groups of four combine their sets. Have children use all of the small triangles to create a shape or design. Tell them to do the same for the other shapes. Then have children trace outlines of their shapes, exchange papers with another group, and then work to figure out which Tangram piece was used to make each larger shape.

## Formative Assessment

Have children try the following problem.

Which Tangram piece could be used to complete the square?



# Try It! 20 minutes | Independent

Here is a problem about solving visual/spatial puzzles.

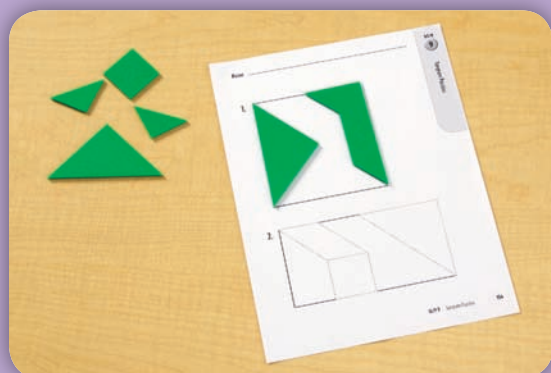
*In Lora's classroom, there are tables that are different shapes. Some are triangles, some are squares, and some are parallelograms. Lora's teacher asks her to push some of the tables together to make a square. How can Lora figure out how to arrange the tables into a square?*

Introduce the problem. Then have children do the activity to solve the problem.

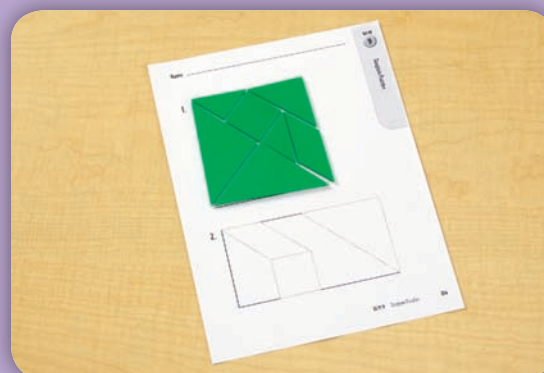
Distribute Tangrams and Tangram Puzzles (BLM 9) to children.

## Materials

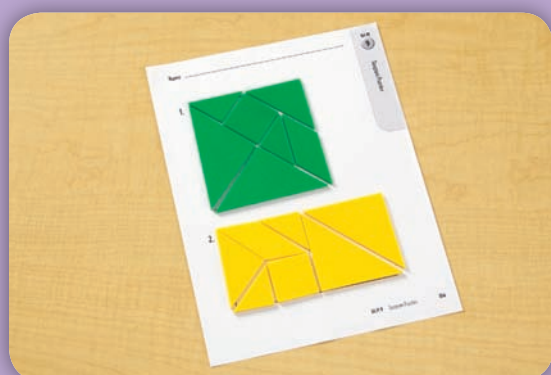
- Tangrams (1 set per child)
- Tangram Puzzles (BLM 9; 1 per child)



**1.** Tell children that they will be using Tangram pieces to fill in the Tangram Puzzles. Have children look at the first puzzle. **Say:** *Some of the shapes you will use are already drawn on the worksheet to help you. Put the matching Tangram pieces on top of those shapes to start the puzzle.* Have children place Tangram pieces over the shapes drawn on the first puzzle.



**2. Say:** *Now fill in the rest of the pieces on the first puzzle.* Allow children time to fill in the puzzle by experimenting with shapes to find out which will fit.



**3.** Once children have completed the first puzzle, allow them to complete the second puzzle on their own.

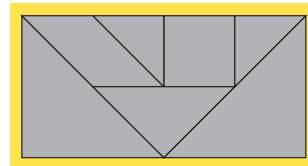
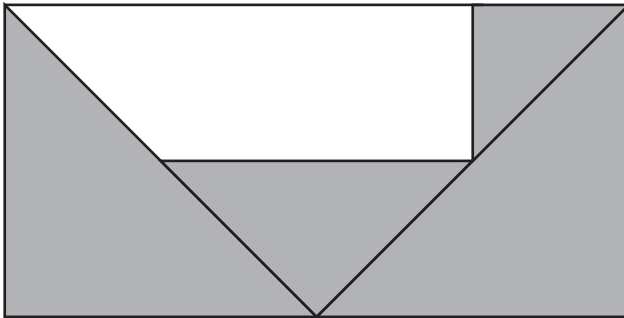
## Look Out!

Watch out for children whose Tangram pieces protrude outside the lines of the puzzle shape. Explain that the Tangram pieces must exactly fill in the puzzle shape, with no leftover space inside the lines and no Tangram parts outside the lines. Have children trace around their Tangram pieces with a crayon and then remove them from the puzzle template. Help children find any spots where the crayon tracing diverges from the puzzle outline.

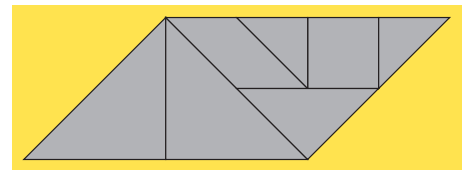
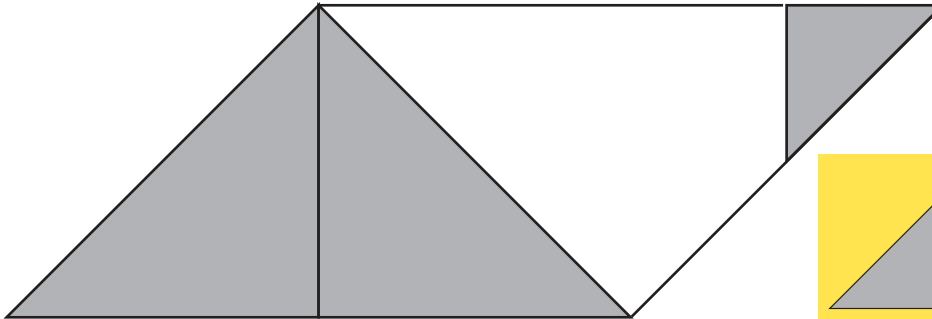
**Use Tangram pieces. Complete the model to make each shape. Draw the shapes in place.**

(Check students' work.)

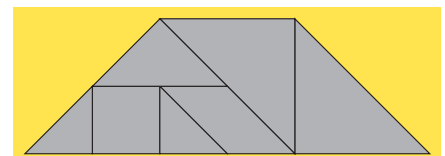
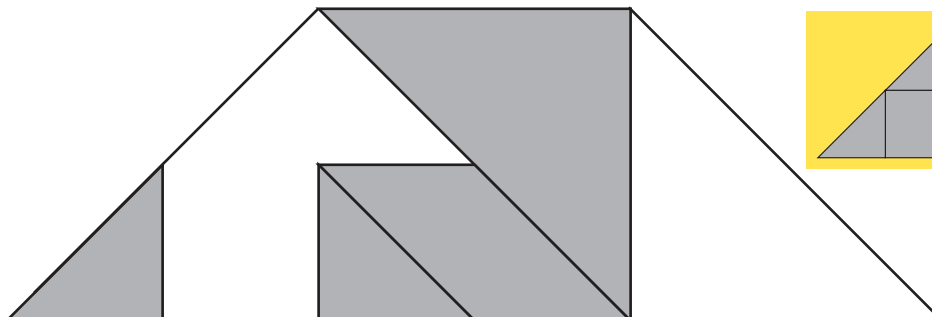
1.



2.



3.





## Answer Key

**Challenge!** How did you decide which Tangram pieces to place in the open spaces to complete the figures on the previous page?

Challenge: (Sample) I tried putting the pieces in the places I thought. If they did not work, I tried a different way.

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## Objective

Partition rectangles into equal shares.

## Common Core State Standards

- **1.G.3** Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters*, and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.

## Geometry

# Equal Shares of Rectangles

A child's early understanding of fractions is usually based on the area model for partitioning a whole. Children start experimenting with this model by partitioning rectangles into two and four equal areas. As they experiment, they learn to use the words *halves*, *fourths*, and *quarters*. Building and partitioning rectangles helps children develop additional mathematical skills, as well. These include spatial reasoning and visualization and a sense of geometric properties.

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

## Talk About It

Discuss the Try It! activity.

- Have children look at the top rectangle on the completed BLM. **Ask:** *How many equal shares are shown? What are two equal shares called?* Have children look at the bottom rectangle. **Ask:** *How many equal shares are shown? What are four equal shares called?*
- Have children compare the size of a half to the size of a fourth. **Ask:** *When we make more equal shares of a rectangle, what happens to the size of the shares?*

## Solve It

With children, reread the problem. Have children draw a picture showing the whole graham cracker and then add a line to show where Marco could break the cracker to make two equal shares.

## More Ideas

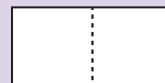
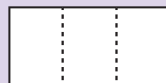
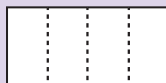
For other ways to teach partitioning rectangles into equal shares—

- Have children use the Color Tiles to build different sized rectangles showing halves and fourths. Ask children to describe each rectangle using the terms *equal shares*, *halves*, *fourths*, and *quarters*.
- Have children use Deluxe Rainbow Fraction® Squares to show halves and fourths and describe the equal shares. Encourage children to make up stories to go with the models they build.
- Have children use Geoboards to show halves and fourths and describe the equal shares.

## Formative Assessment

Have children try the following problem.

*Which shows fourths?*



# **Try It!** 20 minutes | Pairs

Here is a problem about partitioning rectangles into equal shares.

*Marco has a graham cracker that is shaped like a rectangle. He wants to share it equally with his sister. How can Marco break the cracker into two equal shares?*

Introduce the problem. Then have children do the activity to solve the problem. Distribute Color Tiles and the Equal Shares of Rectangles (BLM 10) to children.

## **Materials**

- Color Tiles
- Equal Shares of Rectangles (BLM 10; 1 per pair)
- crayons (1 green, yellow, blue, and red per pair)



**1.** Have children place four green Color Tiles on the BLM in the top rectangle. Then have children fill in the remaining space in the rectangle with yellow Color Tiles. Tell students that if they did not already do so, you want them to arrange the tiles to form two squares inside the rectangle—one green, one yellow.



**2. Ask:** *Are the green and yellow parts equal in size?* If necessary, elicit that they are equal in size and are therefore equal shares. Discuss the words *half* and *halves*. Point out that two halves make a *whole*. Have children take away the green tiles and color that half of the rectangle green; have them take away the yellow tiles and color that half yellow.

## **! Look Out!**

Some children might be confused by using two or four Color Tiles to make each part of a rectangle. Have them focus on the colors as the parts and not on the individual Color Tiles.

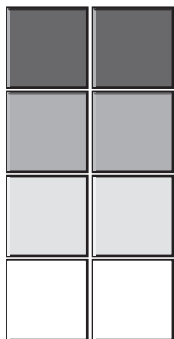


**3.** Have children place two blue Color Tiles, two red Color Tiles, two green Color Tiles, and two yellow Color Tiles on the BLM in the bottom rectangle to form 4 equal parts. **Ask:** *Are the four parts equal shares?* **Say:** *Four equal shares are called fourths, or quarters. Four fourths make a whole. Four quarters make a whole.* Have children color in the fourths.

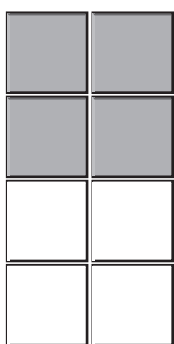
**Use Color Tiles. Build the rectangle. Tell the number of equal shares.**

(Check students' work.)

1. 4 equal shares



2. 2 equal shares



**Draw the rectangle. Tell if it shows halves or fourths. Circle the answer.**

3. four red tiles and four blue tiles

halves    fourths    **halves**

4. two green tiles, two yellow tiles, two red tiles, and two blue tiles

halves    fourths    **fourths**

## Answer Key

**Challenge!** Why are fourths smaller shares than halves?

Challenge: (Sample) Fourths are smaller shares than halves because the whole is divided into four parts, not just two parts.

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