Geometry

In second grade, children describe and analyze shapes. By creating and analyzing two- and three-dimensional shapes, children develop a foundation for understanding geometry concepts such as congruence, similarity, and symmetry, which are necessary for learning in later grades. At this level, children recognize and draw shapes having specified attributes, such as a given number of sides or angles, or equal faces. They identify and name triangles, quadrilaterals (squares, rectangles, and trapezoids), pentagons, hexagons, and cubes.

Children partition rectangles into rows and columns of same-size squares and count to find the total number of them. They answer questions, such as, "How many ways can a square be partitioned into fourths?" This standard is connected with using arrays to work on repeated addition (2.OA.4).

Children also partition circles and rectangles into two, three, or four equal shares (or regions), describe the shapes using the words *halves*, *thirds*, *half of*, *a third of*, etc., and describe the whole as two halves, three thirds, or four fourths. They also learn that equal shares of identical wholes do not need to have the same shape.

The Grade 2 Common Core State Standards for Geometry specify that children should–

- Reason with shapes and their attributes.

The following hands-on activities with manipulatives will help children grasp the geometry concepts presented at second grade. Mathematically proficient second graders accurately use definitions and language to construct viable arguments about mathematics. During discussions about geometry problems, children should be given opportunities to constructively critique strategies and reasoning with their classmates. Teachers will want to ensure there is ample time for children to communicate about shapes and their attributes.

Geometry

Contents

LESSON 1

Objective

Identify characteristics of plane shapes.

Common Core State Standards

- **2.G.1** Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

Geometry

Identify Plane Shapes

Gaining a beginning understanding of basic geometric shapes and terms offers children the opportunity to use a different type of mathematical thinking. Although geometric thinking is related to numerical thinking, becoming familiar with shapes and developing spatial reasoning skills will lay the foundation for understanding in math, science, art, and social studies.

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

Talk About It

Discuss the Try It! activity.

- Have children look at their Shape Recording Sheet (BLM 15). **Ask:** *How many corners does a square have? How many sides?* Repeat for triangles and rectangles.
- Have children compare and contrast two shapes. For example, **ask:** *How is a square the same as a rectangle? How is a square different from a rectangle?* Repeat with other shapes.

Solve It

With children, reread the problem. Then have children draw a picture consisting of only squares, rectangles, and triangles. Instruct children to label each shape in their drawing and describe each shape. For an added challenge, state how many of each shape children are to include.

More Ideas

For other ways to teach about plane shapes—

- Have children use Pattern Blocks to find real-life objects that have the same shape. Encourage children to record the real-life objects that are shaped like each Pattern Blocks shape.
- Give each child a set of Tangrams and have them solve shape riddles. For example, **say:** *I'm thinking of a shape with three sides and three corners.* **Ask:** *What shape is it?* (triangle)

Formative Assessment

Have children try the following problem.

I am a shape with four sides and four corners. All four of my sides are the same length. What shape could I be?

A. triangle

B. rectangle

C. square

Try It! 15 minutes | Pairs

Here is a problem that involves identifying plane shapes.

During story time, Brandon's teacher told the children to sit on the floor. The children were to form a shape that has three straight sides and three corners. How can Brandon and his classmates figure out what shape they are to sit in?

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

Distribute Geoboards, rubber bands, a Shape Recording Sheet (BLM 15), and pencils to children.

Materials

- Geoboard (1 per pair)
- rubber bands (4 per pair)
- Shape Recording Sheet (BLM 15; 1 per pair)
- pencils (1 per child)

1. Instruct children to use the rubber bands to make a shape that has four straight sides of equal length and four corners. Tell children to count how many units each side is to be sure they are equal. Guide children to identify the shape as a square. **Ask:** *Is this the shape that the children are to sit in?*

2. Have children write "square" on their recording sheet and record the number of sides and corners this shape has.

3. Repeat Steps 1 and 2 for a rectangle and a triangle. After each shape has been made, **ask:** *Is this the shape that the children are to sit in?*

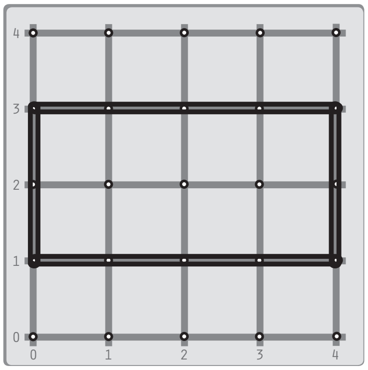
Look Out!

Make sure that children understand the difference between a square and a rectangle. Both have four sides and four corners. Reinforce the fact that in squares all four sides are of equal length. In rectangles only the opposite sides are equal, but all four sides are not.

Use a Geoboard and rubber bands. Make each shape. Tell the number of sides and corners.

(Check students' work.)

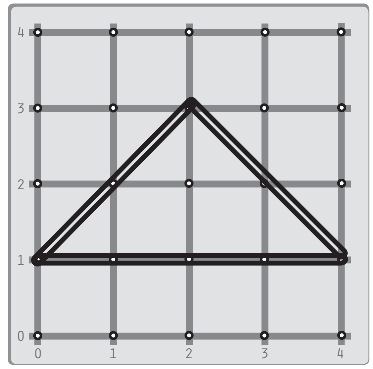
1.



sides 4

corners 4

2.

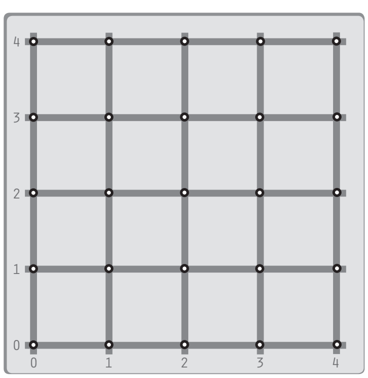


sides 3

corners 3

Use a Geoboard and rubber bands. Make each shape. Draw it. Tell the number of sides and corners.

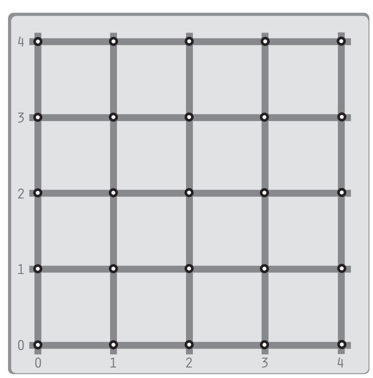
3. square



sides 4

corners 4

4. triangle



sides 3

corners 3

Answer Key

Challenge! Can a shape have more sides than corners? Explain your answer.

Challenge: (Sample) No; two sides meet to make each corner. Each side is used twice, so for every side, there is a corner.

LESSON 2

Geometry

Building Cubes and Prisms

Objective

Identify characteristics of cubes and rectangular prisms.

Common Core State Standards

- **2.G.1** Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

In grades 1 and 2, children become adept at exploring, describing, and representing the three-dimensional shapes in their environment. They explore three-dimensional shapes through composing and decomposing them, which augments their understanding of the nature of the shapes. Children need to see three-dimensional shapes in a variety of orientations and locations so that their understanding of the shapes encompasses real-life situations. Children also should make connections between two-dimensional shapes as they appear in three-dimensional solids.

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

Talk About It

Discuss the Try It! activity.

- Display the cubes. **Ask:** *What is this shape called? What do we know about all the faces on this shape?*
- **Ask:** *How many faces does a cube have? How many edges and corners? What are some things you see every day that are shaped like cubes?*
- Display two cubes to form a rectangular prism. **Ask:** *What shape do I have? How many faces, edges, and corners does it have? What are some things you see every day that are shaped like rectangular prisms?*
- **Ask:** *What is an easy way to tell the difference between a cube and a rectangular prism?* (Cubes have faces that are all squares.) *What do you know about the number of faces, edges, and corners of these two shapes?* (Both shapes have the same number of faces—6, edges—12, and corners—8.)

Solve It

With children, reread the problem. Then have children write letters to Mrs. Talbot explaining how cubes and rectangular prisms are alike and different. Encourage children to use key words such as *faces, edges,* and *corners.*

More Ideas

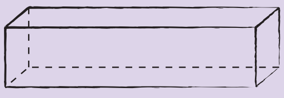
For other ways to teach about rectangular prisms—

- Have children use Snap Cubes® to create two larger cubes with the same dimensions (2 × 2 × 2). Then guide children to combine the two cubes to form a rectangular prism (4 × 2 × 2).
- Have children use Color Tiles to create squares or rectangles in a two-dimensional array (2 × 2 or 2 × 3). Then have children use Snap Cubes and the dimensions of the tile arrays to create cubes and rectangular prisms having faces with the same dimensions.

Formative Assessment

Have children try the following problem.

How many edges does this figure have?



Try It! 20 minutes | Groups of 3

Here is a problem about cubes and rectangular prisms.

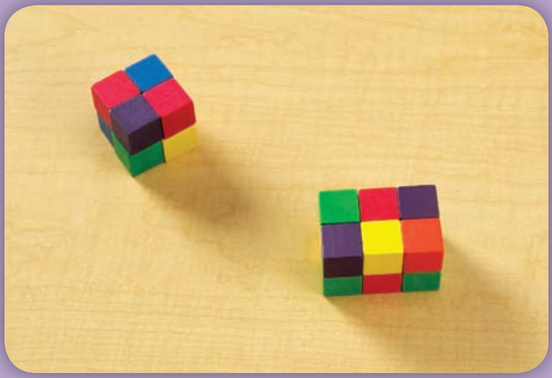
Mrs. Talbot has 20 boxes of books. Each box is square on all sides. Mrs. Talbot wants to arrange the boxes at the back of the room to make 2 large shapes. She builds a cube using 8 boxes. She builds a rectangular prism with 12 boxes. How many faces, edges, and corners does each shape have?

Introduce the problem. Then have children do the activity to solve the problem. Distribute the materials to children. Introduce and define the terms *face, edge,* and *corner.* Provide examples of each.

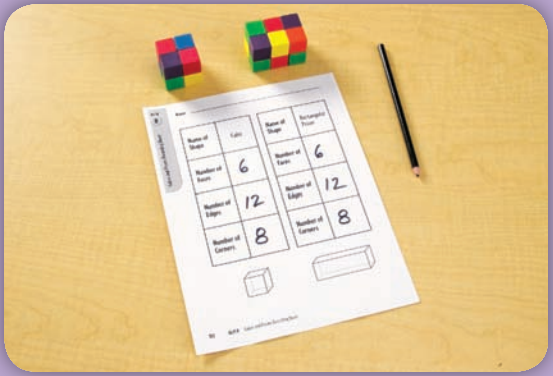
Materials

- 2-cm Color Cubes (20 per group)
- Cubes and Prisms Recording Sheet (BLM 16; 1 per child)
- pencils (1 per child)

1. Have children count the faces, edges, and corners on the cube. Establish that a cube is a shape that has square faces on all sides. Challenge children to use 8 cubes to make a large cube, like Mrs. Talbot did (2 × 2 × 2). Point out the faces, edges, and corners, making sure to concentrate on the attributes of the large cube formed, not each individual cube.



2. Guide children to build a rectangular prism measuring 1 × 1 × 2 using cubes. Discuss the differences between the rectangular prism and the cube shapes they built (concentrate on square faces versus rectangular faces on the two shapes). Challenge children to add the remaining cubes to the rectangular prism to make one that uses 12 cubes, like Mrs. Talbot did (3 × 2 × 2). Discuss the faces, edges, and corners on the large rectangular prism.



3. Have children complete the recording sheet while using their cube and rectangular prism models to guide them. Discuss the similarities and differences between the data and the way the two shapes look.

⚠ Look Out!

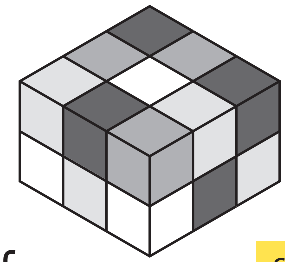
If children cannot count the number of faces (or edges or corners) correctly, ask them to touch each face (or edge or corner) as they count it. Reinforcing the number with a kinesthetic experience should help children count correctly. You might mark a face with tape to ensure it is not recounted. Also watch for children who count the edges of two faces separately, even when they are put together to form one edge.

Answer Key

Use 2-cm Color Cubes. Build each prism. Tell the number of faces, edges, and corners.

(Check students' work.)

1.

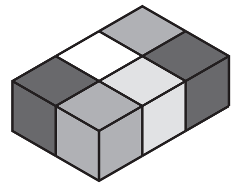


faces 6

edges 12

corners 8

2.



faces 6

edges 12

corners 8

Use 2-cm Color Cubes. Build each prism. Draw the prism. Tell the number of faces, edges, and corners.

3. 3 cubes long
3 cubes wide
3 cubes tall

faces 6

edges 12

corners 8

4. 2 cubes long
4 cubes wide
3 cubes tall

faces 6

edges 12

corners 8

Answer Key

Challenge! Does a solid shape have more faces, corners, or edges? Is that always true?

Challenge: edges; yes

LESSON 3

Objective

Partition rectangles into rows and columns.

Common Core State Standards

- **2.G.2** Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.

Geometry

Partitioning Rectangles

The concept of area ties together several strands of mathematics, including measurement, geometry, and number skills. As a transition to solving for area, children learn to partition rectangles into arrays of equal squares. This exposes them to the basic notion of area without the need for computation. Understanding attributes of rectangles and squares and having a sense of number will help children visualize area. Moreover, partitioning rectangles into arrays leads to the development of multiplication skills.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *What shape is the blanket? What do you know about rectangles? Why are there more rows than columns? How many rows are there? How many columns are there?*
- **Ask:** *How many color squares did you count in the rectangle?* Elicit that there are 8 rows of 5, and have children count the squares by 5s.
- **Ask:** *What if Maria and her grandmother decide the blanket is too small or too large? How many squares would there be if they added a row? Added a column? Subtracted a row? Subtracted a column?*

Solve It

With children, reread the problem. Have children draw the blanket with 8 rows of 5 squares. Have children count the total number of squares and write a sentence telling how many squares Maria and her grandmother need for the blanket.

More Ideas

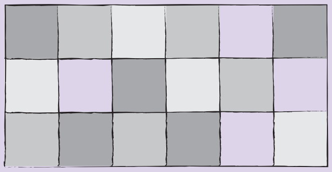
For other ways to teach partitioning rectangles—

- Have pairs use Geoboards and the Four-Section Spinner (BLM 14) to create rectangles. Have them number the spinner 1–4 and spin twice for the number of squares across and the numbers of squares down for a rectangle. Have children partition the rectangle into rows and columns of squares and count how many squares there are in the rectangle.
- Have children use Geoboards to make various rectangles. Have them exchange boards with a partner and partition the rectangle into as many rows and columns of squares as they can. Then have them count to tell how many squares.

Formative Assessment

Have children try the following problem.

How many small squares are in this rectangle?



A. 18 **B.** 12 **C.** 9

Try It! 30 minutes | Pairs

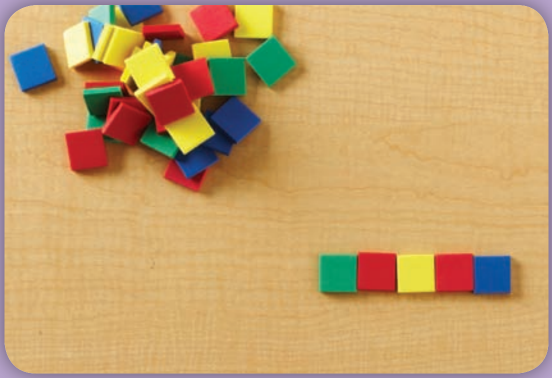
Here is a problem about partitioning rectangles.

Maria is helping her grandmother make a blanket. She is designing a pattern for the blanket using red, blue, yellow, and green squares. The pattern is 8 rows of squares with 5 squares in each row. All the squares are the same size. How many squares are in the pattern?

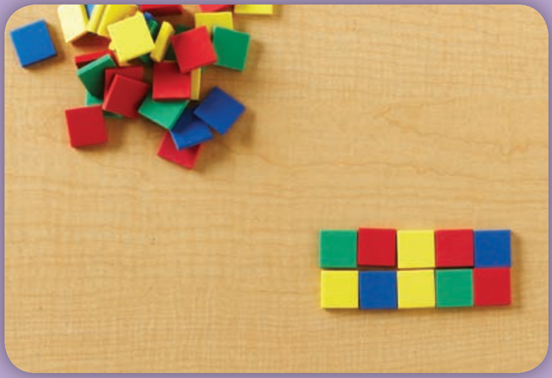
Introduce the problem. Then have children do the activity to solve the problem. Distribute Color Tiles to children.

Materials

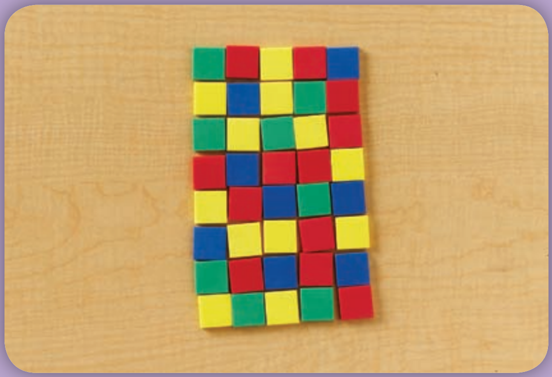
- Color Tiles (40 per pair)



1. Draw a rectangle on the board and model partitioning the rectangle into rows and columns. Explain that rows run left and right and columns run up and down. Discuss the blanket pattern with children. **Ask:** *How many squares are in each row?* Have children build the first row.



2. Have children add the second row of the pattern to form a 2 by 5 rectangle. Elicit from children that as they add additional rows they will be building larger rectangles. Elicit further that each new rectangle will still be made of equal-size squares.



3. **Ask:** *How many rows are in Maria's design?* Have children finish the blanket design. **Say:** *Let's find out how many squares there are in Maria's blanket pattern. Count the squares.* **Ask:** *How many squares are needed for the blanket?*

⚠ Look Out!

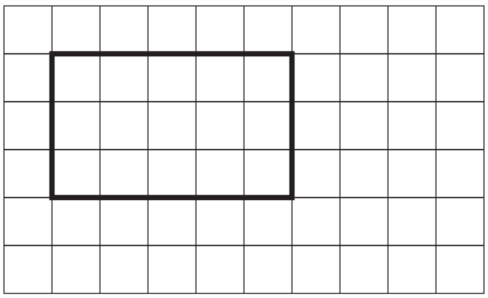
Watch for children who count the same tiles twice or skip a tile because they are losing track of what they have counted. Suggest that they move the tiles slightly to help them keep track.

Answer Key

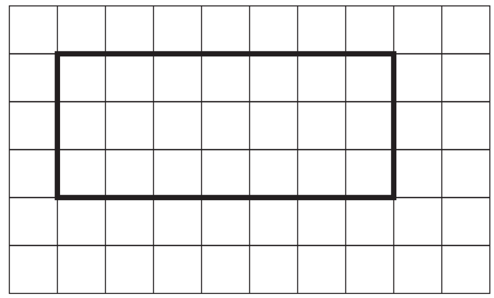
Use Color Tiles. Build each model. Find the number of small squares in each rectangle.

(Check students' work.)

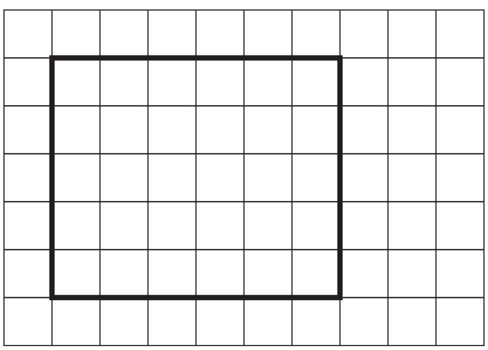
1. 15



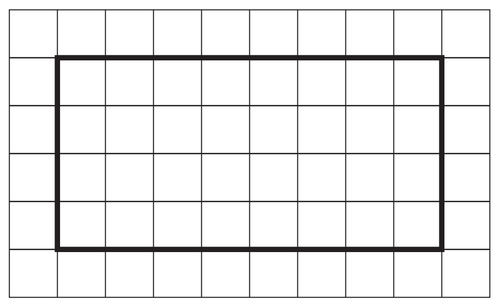
2. 21



3. 30



4. 32



Read the story. Draw the rows and columns. Count the squares.

5. Gary is making a game board. It has 4 rows and 5 columns. It has ______ squares.

4 rows of 5 squares, 20

Answer Key

Challenge! Mrs. Chan is making a class quilt. She has 24 children in her class. Each child will design 1 square. If she is making 6 columns on her quilt, how many rows of squares will there be? Draw the quilt to show the rows and columns of squares.

Challenge: 4 rows; Children should draw a rectangle with 4 rows of 6 squares.

LESSON 4

Objective

Recognize fractions as parts of a whole.

Common Core State Standards

- **2.G.3** Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves, thirds, half of, a third of,* etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.

Geometry

Recognizing Fractions

Introducing the basic concept of fractions to children helps them develop a foundation for deeper learning in years to come. Children need to recognize when items or sets have been divided into equal parts and to become familiar with some of the basic terminology related to simple fractions. It is important for children to understand that *equal parts* means that each person gets exactly the same amount when splitting.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many yellow Cuisenaire® Rods make a train that is just as long as the orange rod? What fraction of the orange rod is one yellow rod?* Guide children to understand that a yellow rod represents one-half of the orange rod.
- **Ask:** *How many red rods equal one dark green rod? What fraction of the dark green rod is one red rod?* (one-third) *How many thirds make up one dark green rod?*
- **Ask:** *How many white rods equal one purple rod? What fraction of the purple rod is one white rod?* (one-fourth) *How many fourths make up one purple rod?*

Solve It

With children, reread the problem. Then have children find how many green rods make up one blue rod. Have them draw a blue rod with three green rods below it to show their answer to the problem.

More Ideas

For other ways to teach about fractions as parts of a whole—

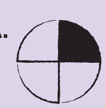
- Have children make Snap Cubes® trains of two, three, or four cubes. Then ask them to identify the parts that make up the whole train. For example, for a train of four cubes, ask children how many parts make up the whole. Ask them if the parts are fractions. Help them understand that one cube represents one-fourth of a four-cube train.
- Have pairs of children work with Pattern Blocks. Instruct them to select a large hexagon. Then have them see how many triangles it takes to cover the surface of the larger shape. Repeat using several combinations of large and small shapes. Discuss that the small shapes can be used to show fractions of the larger shapes.

Formative Assessment

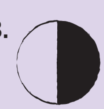
Have children try the following problem.

Put an X under the circle that shows $\frac{1}{3}$.

A.



B.



C.

Try It! 20 minutes | Groups of 4

Here is a problem about recognizing fractions as part of a whole.

Mario's class is using Cuisenaire Rods to learn about fractions. How can Mario find the number of light green rods that make up one blue rod?

Introduce the problem. Then have children do the activity to solve the problem. Explain that the word *fraction* means equal parts or pieces of a whole. Tell children that if a whole cake is cut into 8 equal pieces, then each piece is a fraction of the whole cake. Distribute Cuisenaire Rods, worksheets, and crayons to children.

Materials

- Cuisenaire® Rods (1 set per group)
- Rod Worksheet (BLM 17; 1 per child)
- crayons (1 crayon for every rod color per child)

1. Hold up an orange rod and explain that it represents one whole unit. Ask children to color the first rod on the Rod Worksheet to show one whole. This means that they will color the whole rod the same color. Then ask children to make a train of yellow rods that is the same length as the orange rod.

2. Explain that the small yellow rods represent fractions of the orange rod. Tell children that since two yellow rods equal one orange rod, each yellow rod is one-half of the whole. Have children color the second rod on the Rod Worksheet to show one-half of the whole.

3. Repeat using other rods to represent whole units. Have children practice finding halves, thirds, and fourths, and representing them on the Rod Worksheet. **Ask:** *How many light green rods make up a blue rod?*

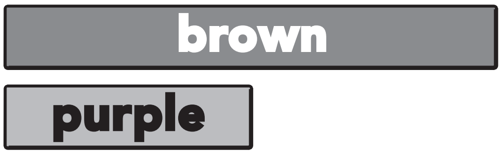
⚠ Look Out!

Children may try to use a variety of colors to make equivalent trains. Remind them that fractions are equal parts of the whole, and they must use the same color to represent equal parts.

Geometry

Use Cuisenaire Rods. Make each model.
Fill in the blanks. (Check students' work.)

1.



__2__ purple rods = 1 brown rod

1 purple rod equals __$\frac{1}{2}$__ of a brown rod.

2.

__3__ green rods = 1 blue rod

1 green rod equals __$\frac{1}{3}$__ of a blue rod.

Use Cuisenaire Rods. Use the rods named.
Draw the model. Fill in the blanks.

3. green and dark green

1 green rod equals __$\frac{1}{2}$__ of a dark green rod.

4. red and brown

1 red rod equals __$\frac{1}{4}$__ of a brown rod.

Answer Key

Challenge! If it takes 3 rods to equal one whole unit, what part of the whole is the smaller rod?

Challenge: $\frac{1}{3}$

LESSON 5

Geometry

Identifying Unit Fractions

Objective

Identify and show halves, thirds, and fourths of regions.

Common Core State Standards

- **2.G.3** Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves, thirds, half of, a third of,* etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.

Fractions will play an important role in children's lives, and learning the basic concepts of unit fractions will give them a foundation on which they can build in the future. Being able to recognize that one-half, one-third, and one-fourth each represent equal parts of a whole will help children understand a variety of concepts, including telling time, counting money, and measurement.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many parts were there when you first made the square?* Help children understand that the square represented one whole.
- **Ask:** *When you added another rubber band, how many parts were there? Were the parts the same size? How could you tell?*
- **Ask:** *What do we call two equal parts of one whole?*
- **Ask:** *Can you divide your Geoboard into 4 equal parts that are not the same shape?*

Solve It

With children, reread the problem. Then have children draw a square to represent the gym. Have children draw a line to divide the gym in half. Extend the activity by having children draw two more squares and show what it would look like if the gym were divided into fourths and thirds. Instruct children to write one sentence about each drawing explaining which fraction is represented.

More Ideas

For other ways to teach about identifying simple fractions—

- Have children trace different Pattern Blocks shapes and then practice dividing the tracings into halves, fourths, and thirds.
- Have children work with a partner. Distribute Snap Cubes® to children and have them build a train. Have children trace their train four times, and divide one tracing into halves, one into fourths, and one into thirds. Have them compare the divided tracings with the undivided one so they can track the fractional division.

Formative Assessment

Have children try the following problem.

Draw lines in the squares so they match the labels.

A. halves　　**B.** thirds　　**C.** fourths

Try It! 20 minutes | Groups of 3

Here is a problem about identifying simple fractions.

It was raining, so Billy's class had to play in the gym for recess instead of going outside. Billy's teacher asked Billy and his friends to use a rope to divide the gym in half, one side for basketball and one side for dodgeball. How will Billy and his friends know how to place the rope?

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

Distribute Geoboards and rubber bands to children.

Materials

- Geoboard (1 per group)
- rubber bands (5 per group)

1. Have children make a square that is 4 units by 4 units on the Geoboard. Tell them to use another rubber band to divide the square into two equal parts. Explain that each smaller part is called a *half*.

2. Instruct children to count the units in each half of the square to verify that the parts are equal.

3. Have children divide the square into four equal parts. Explain that each part is called a *fourth*. Have children count the units in each section. To repeat with thirds, adjust the size to a 3 × 3 square or 3 × 2 rectangle.

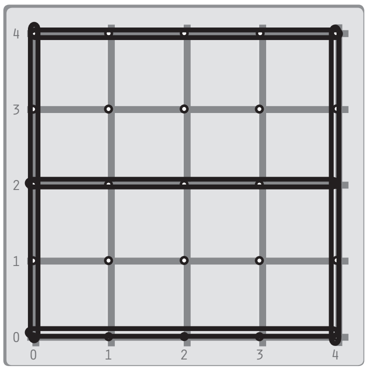
⚠ Look Out!

Children may believe that any shape divided into two parts represents two halves, or that any shape divided into three parts represents thirds, and so on. Remind children that the parts must be equal. Reinforce this as children count the units in each section of the square during the Geoboard activity.

Answer Key

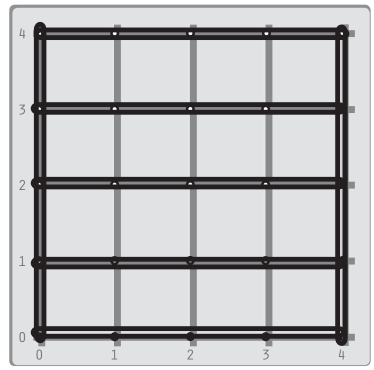
Use a Geoboard. Make the model shown. Into how many equals parts is the shape divided? (Check students' work.)

1.



2 equal parts

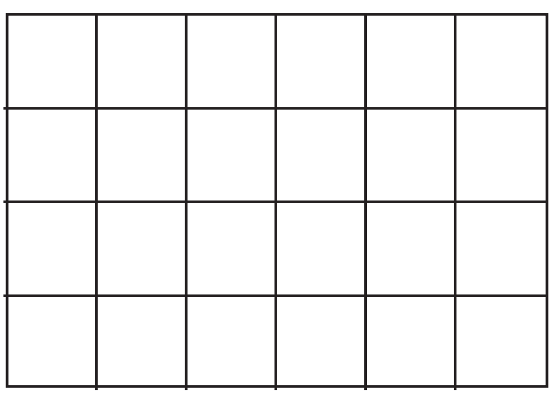
2.



4 equal parts

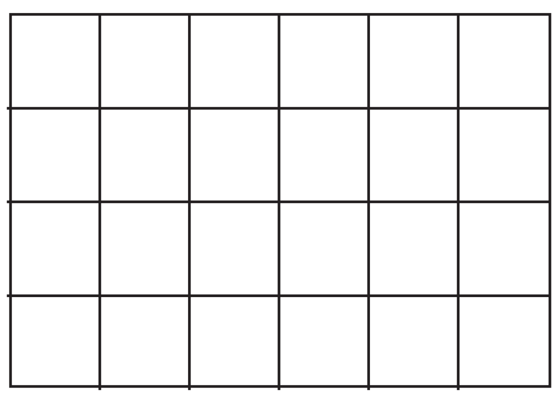
Make a model on the grid that has equal parts. Use the number given. Draw the model. (Check students' work.)

3. 3



How many grid squares are in each part? 8

4. 4



How many grid squares are in each part? 6

Answer Key

Challenge! If a shape is divided into five equal parts, what part of the whole shape is each part?

Challenge: $\frac{1}{5}$