Geometry

In seventh grade, students reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions. They gain familiarity with the relationships between angles formed by intersecting lines and understand the characteristics of angles that create triangles. They think about questions such as, "What segment lengths will form a triangle?"

Additionally, students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. Students describe a face shape resulting from cuts made parallel and from cuts made perpendicular to the bases of right rectangular prisms and pyramids.

Students at this level also solve problems involving area and circumference of a circle. **Area** is the measure of a two-dimensional space enclosed by a shape–the region inside a shape. **Circumference** is the distance around a circle–the "perimeter" of a circle.

Students also solve problems involving area, volume, and surface area of two- and three-dimensional objects. **Surface area** is the total area that can be measured on an entire three-dimensional **surface**–for example, the sum of the areas of a polyhedron's faces. **Volume** is the space filled, or occupied, by a three-dimensional object.

The Grade 7 Common Core State Standards for Geometry specify that students should–

- Draw, construct, and describe geometrical figures and describe the relationships between them.
- Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

The following hands-on activities in geometry enable teachers to help students realize that memorizing a formula does not mean comprehending the formula. Teachers will help students understand that knowing why a formula works is more important than memorizing it. For example, at this level, students learn the formulas for determining the area and circumference of a circle and use those formulas to solve problems. With a hands-on understanding of the formulas, students can readily recall or even generate the formulas as needed.

Geometry

Contents

LESSON 1

Objective

Construct figures using scale factors of 2 and 3.

Common Core State Standards

- **7.G.1** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Geometry

Scale Factor

The concept of proportionality is a key concept for students in the 7th and 8th grades. Students are expected to develop facility with ratios, rates, and proportions. This includes solving problems related to scale and the properties of similar figures. Students also need to develop their computational skills with rational numbers.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *Which AngLegs piece will complete the right triangle?*
- **Ask:** *What are the dimensions of the second ramp? What is the scale factor when compared to the first ramp?*
- **Ask:** *What are the dimensions of the third ramp? What is the scale factor when compared to the first ramp?*
- **Ask:** *What is the scale factor if you compare the third ramp to the second ramp that Jonathan and his friends built?*

Solve It

Reread the problem with the students. Ask students to describe the relationship between the first and second triangles. Have students write a paragraph identifying what they know about the lengths of the sides of the three triangles and what they know about the angles of the triangles.

More Ideas

For other ways to teach about scale factors—

- Students can use the XY Coordinate Pegboard to “grow” triangles with a given scale factor. They can also create square and rectangular structures on the board.
- Challenge students to build additional similar triangle triples with other AngLegs® pieces. (They do not have to be right triangles.) Have them compute the dimensions of the sides of the similar triangles.
- Have students make a large triangle on a Geoboard. Tell them to add a segment (rubber band) parallel to one side of the original triangle. Have them measure the corresponding sides of the two triangles and find the scale factor. Caution students that the scale factor will probably not be a whole number.

Formative Assessment

Have students try the following problem.

Amanda is building a $\frac{1}{12}$ scale model of an ultralight airplane. If the actual airplane has a wingspan of 30 feet, what will the wingspan of the model be?

A. 2.5 feet **B.** 3 feet **C.** 4 feet **D.** 12 feet

Try It! 30 minutes | Pairs

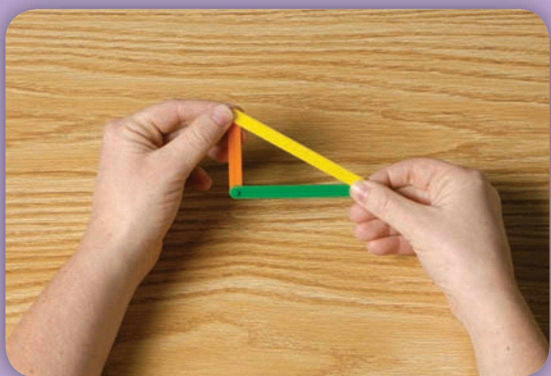
Here is a problem about scale.

Jonathan and his friends are designing and building a dirt bike course. They want to construct three takeoff ramps that are different sizes but that are similar in shape. The length (slanted portion) of the first, and smallest, ramp will be 1.87 meters. What will be the lengths of the second and third ramps if the friends use scale factors of 2 and 3 to build them?

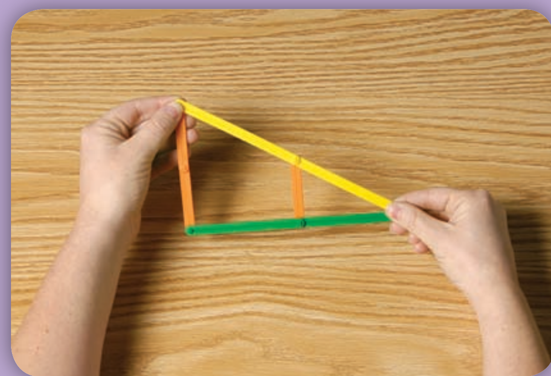
Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials.

Materials

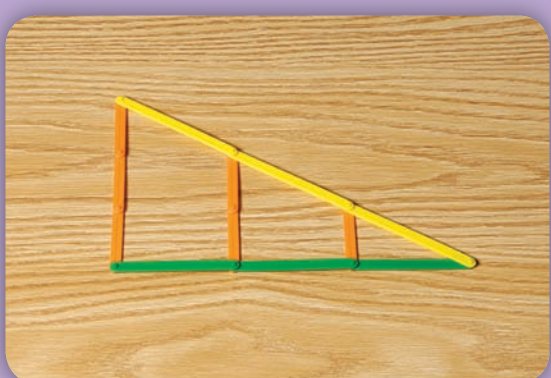
- AngLegs® (at least 3 green, 3 yellow, and 6 orange)



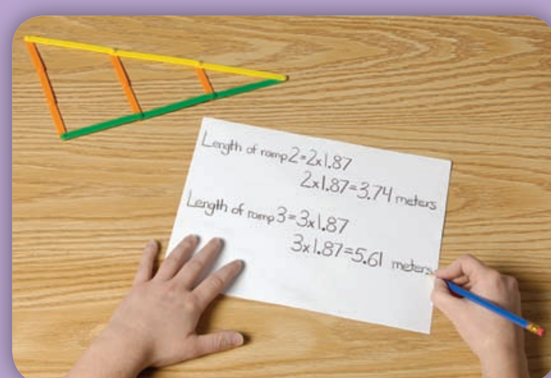
1. Say: *Construct a right angle with a green AngLegs piece as the base and an orange piece as the "upright."* Have students find the AngLegs piece that completes the right triangle (yellow). **Say:** *Now you have constructed the smallest ramp.*



2. Say: *Extend each of the sides of the ramp with AngLegs pieces of the appropriate color.* Be sure students realize that they will need two orange pieces to form the "upright" of the larger triangle. **Say:** *The scale factor of this larger triangle is 2 because each side of the triangle is two times the original.* Remind students that the dirt bike ramps are like these similar triangles.



3. Say: *Extend each side again by adding another AngLegs piece of the same color as the others on that side.* This forms another, larger triangle whose dimensions have a scale factor of 3.

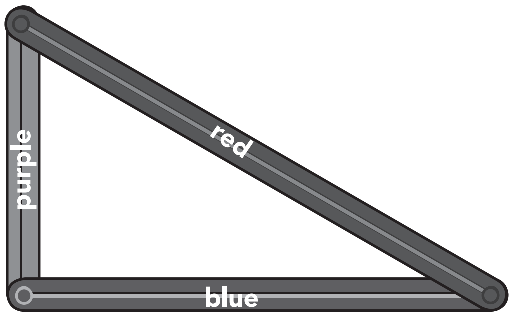


4. Say: *You have constructed models of three different, but similar, ramps.* **Ask:** *In the story problem, what is the length of the first ramp?* **Ask:** *What is the scale factor for the second ramp? What is its length?* **Ask:** *What is the scale factor for the third ramp? What is its length?*

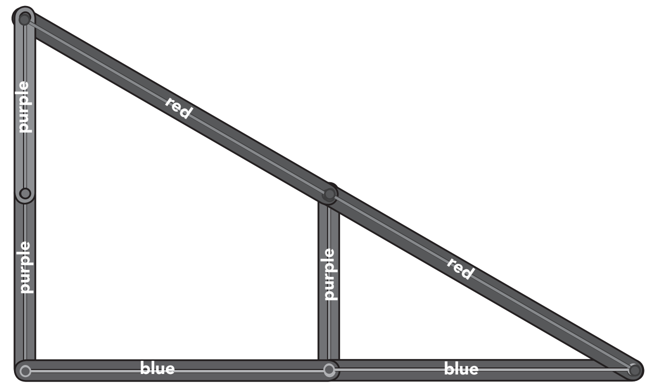
Use AngLegs to model the triangles shown. Write the scale factor for Triangle 2.

(Check students' work.)

1. Original Triangle



Triangle 2



The scale factor of Triangle 2 is 2.

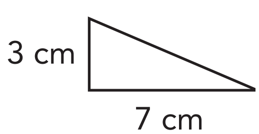
Using AngLegs, build a triangle with the legs named. Then build a triangle with a scale of 3:1. Sketch the models.

2. orange, yellow, and purple

Check students' models.

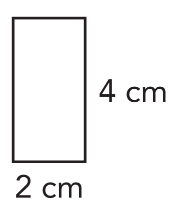
Draw each figure using the scale factor given.

3. scale factor of 2



The triangle has height 6 cm and base 14 cm.

4. scale factor of 3



The rectangle has length 6 cm and width 12 cm.

Answer Key

Challenge! Triangle B has a scale factor of 2:1 to Triangle A. Which triangle is larger and by how much? Draw a picture.

Challenge: (Sample) Triangle B is 2 times bigger than Triangle A.

LESSON

2

Objective

Investigate conditions for building triangles.

Common Core State Standards

- **7.G.2** Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

Geometry

Construct Triangles

Triangles are polygons with three sides, and they are classified by their sides and angles. The sum of the angles of any triangle is 180°, and the sum of the lengths of any two sides in a triangle must be greater than the third side. When a figure does not meet all of these conditions, it is not a triangle. With an appropriate manipulative, students can effectively investigate conditions for building triangles. Students can determine whether a set of conditions defines one unique triangle, more than one triangle, or no triangle.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *Why was the green AngLegs® piece too short?* Elicit that the red piece was too long and/or the 45° angle was too large.
- **Say:** *Describe what happened with the yellow piece.* If necessary, explain that the yellow piece was just long enough to make a triangle.
- **Say:** *Describe what happened with the blue piece.* Elicit that the blue piece was long enough to swing through two points on the third side, so it was possible to form two triangles.
- Discuss the ways to define triangles. For example, explain that a triangle can be defined by its 3 sides, by 2 sides and the angle between them, by 1 side and it's 2 adjacent angles, and so on.

Solve It

Reread the problem with students. Have students draw the triangles they made. Have them include the angle measures—(45°, 45°, 90°), (10°, 45°, 125°), (45°, 55°, 80°). Have students answer the question in the problem. Discuss.

More Ideas

For another way to teach about constructing triangles—

- Have students use a protractor and ruler to draw triangles given certain conditions. Include conditions that lead to one triangle, two triangles, and no triangle. With an emphasis on precise measurements, students will be able to make accurate determinations.

Formative Assessment

Have students try the following problem.

Miguel measures two sides of a sail: 15 feet and 8 feet. Which could be the measurement of the third side?

A. 6 feet **B.** 10 feet **C.** 23 feet **D.** 30 feet

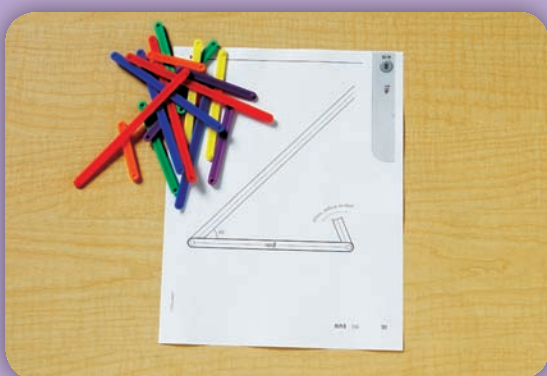
Try It! 25 minutes | Pairs

Here is a problem about constructing triangles.

Hannah is designing a triangular pen for her miniature play horses. She has some AngLegs to investigate different triangles. She is fixing one angle at 45° and she is fixing two of the side lengths by using a red AngLegs piece for the first side and blue, green, or yellow for the second side. Help Hannah investigate the triangles she can build. Which triangle is best?

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

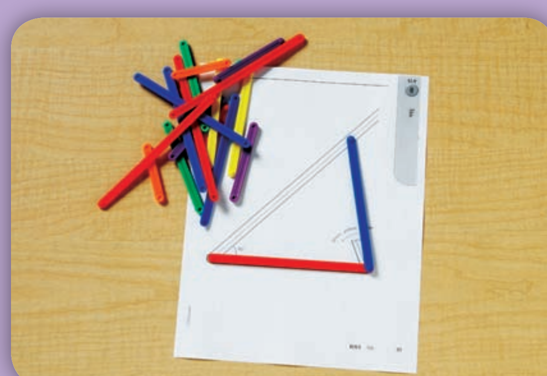
Materials
- AngLegs® (3 of each color)
- BLM 8
- colored pencils
- straightedge



1. Have students study the BLM. Have them note the fixed angle of 45°. Have them identify where to place the red AngLegs piece and where they will be attaching the green, yellow, and blue pieces in subsequent steps. Note that the long gray side represents an unknown third side of the triangle that students will try to make.

2. Say: *Put a red AngLegs piece in its place on the diagram. Now let's choose the second side. Attach a green piece to the right end of the red piece.* Have students tell whether they are able to form a triangle. Elicit that they cannot, because the green piece is too short. **Ask:** *How would you change the 45° angle or the red side to make a triangle?*

3. Have students try a yellow piece in place of the green piece. **Ask:** *Can you make a triangle*? *Is that the only triangle you can make*? Elicit that it is. Suggest that an AngLegs piece will fit as the third side, and have students find that it is a yellow piece. Have them build the triangle and measure and record all the angles.



4. Have students try a blue piece in place of the yellow piece. **Ask:** *Can you make a triangle*? *How many*? Elicit that two different triangles can be made. **Ask:** *What would you do to the 45° angle so that only one triangle could be made? So that no triangle could be made?*

Answer Key

Use the AngLegs shown. Determine whether you can build a triangle.

(Check students' work.)

1.

Can you build a triangle? No

Using AngLegs, try to make at least one triangle. Draw the triangle(s) or write an explanation if no triangle can be made.

2. Angles: 30°, 60°, 90°

Possible; red-blue-purple and yellow-green-orange

3. Sides: orange, orange, yellow

Not possible; sum of short sides equals long side

4. Angles: 30°, 30°, 60°

Not possible; sum of angles not 180°

5. Sides: blue, green; Angle between: 45°

Possible; blue-green-green

Answer Key

Challenge! Can you define a triangle by naming its three angles? Explain.

Challenge: (Sample) No. Naming the three angles does not tell us which triangle it is. For any three angles whose sum is 180°, there are an infinite number of triangles, all a different size.

LESSON

3

Objective

Find the circumference of a circle.

Common Core State Standards

- **7.G.4** Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

Geometry

Circumference of a Circle and π

Students look at the ratio of circumference to diameter for various circles and develop both an approximation of the value of π and the formula for finding circumference. While a single circle shows the ratio, a larger number of examples helps students recognize the consistency of the ratio and provides a stronger basis for making a generalization.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *When might it be more useful to use $\frac{22}{7}$ as an approximation for π? When might it be more useful to use 3.14 for π?*
- **Ask:** *How would you find the circumference of a circle if you know its radius?* Explain that since the diameter is twice the length of the radius, the value $2r$ can be substituted for d in the formula for finding circumference: $C = \pi d = 2\pi r$.
- **Ask:** *How can you find the diameter of a circle if you know its circumference?*

Solve It

Reread the problem with students. Have students explain how to find the circumference of a circle when the diameter is known. Then have them find the length of ribbon Kaden needs to fit exactly around the top edge of the can.

More Ideas

For other ways to teach about circumference and π—

- Have students trace the inner and outer circles of the Rainbow Fraction Circle Rings and then measure the circumferences of the traced circles to develop the concept of π.
- Provide each group with a different circular object, such as a Two-Color Counter, spinner, Deluxe Rainbow Fraction® Circles, or Relational GeoSolids® cylinder. Have each group find the ratio of circumference to diameter of their object. Record results on the board and have students generalize the ratio—that is, determine π.

Formative Assessment

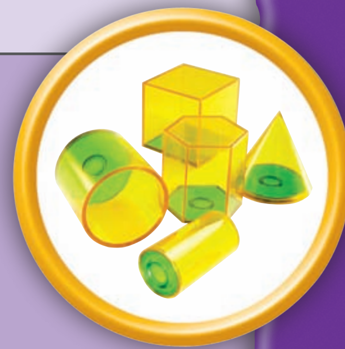
Have students try the following problem.

The diameter of a circle is 52 inches. Which expression can you evaluate to find the circumference?

A. 52 ÷ π **B.** π ÷ 52 **C.** 52 × π **D.** 26 × π

Try It! 30 minutes | Groups of 4

Here is a problem about finding the circumference of a circle.

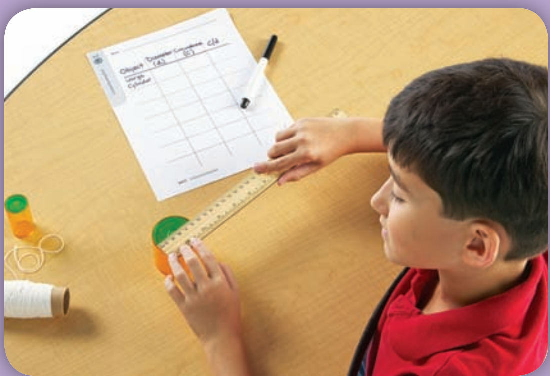


Kaden is decorating a can for his mother to store her small crafts. He wants to glue a piece of ribbon to the top edge of the can so that it goes around the can exactly one time. How much ribbon does he need if the diameter of the can is 14 cm?

Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials. Have students start a recording chart with these headings: *Object, Diameter (d), Circumference (C),* and $\frac{C}{d}$.

Materials

- Relational GeoSolids® large and small cylinder (1 set per group)
- other circular objects (optional)
- BLM 9
- paper (1 sheet per group)
- string (2 feet length per group)
- centimeter rulers (1 per group)
- calculators (1 per group)



1. Have students measure the diameter and circumference of the base of the large and small cylinders and record each measurement to the nearest tenth of a centimeter. Then have students divide to complete the chart.

2. Have students measure the diameter and circumference of other circular objects to the nearest tenth of a centimeter and complete the table. **Ask:** *What pattern do you see in the measurements?* Write the symbol π on the board. **Say:** *This symbol is called* pi. *We often use 3.14 or* $\frac{22}{7}$ *to approximate its value.*

3. Ask: *How can you find the circumference of a circle if you know its diameter? What formula can you use?* Write $C = \pi \times d$ on the board. **Say:** *Add a circle with a diameter of 14 cm to your recording sheet. Use the formula to find the circumference.*

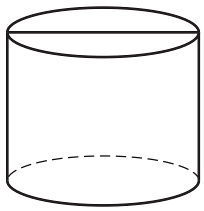
⚠ Look Out!

Be sure that students measure each diameter and circumference correctly. Remind them to measure the diameter at the widest part of the circle. This will help students calculate a more accurate number for π. Explain to students that π is the same for any circle, no matter how big or small. Students' calculations for π may differ slightly.

Use Relational GeoSolids to model each cylinder. Use a ruler to find the diameter of the base. Find the circumference of the base. Use 3.14 for π.

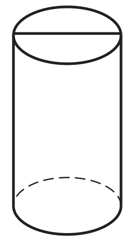
(Check students' work.)

1.



Answers will vary depending on size of Relational GeoSolids available.

2.



Answers will vary depending on size of Relational GeoSolids available.

Draw a circle that has each diameter. Find the circumference of the circle. Use 3.14 for π.

3. 3 inches

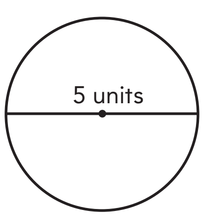
9.42 in.

4. 11 centimeters

34.54 cm

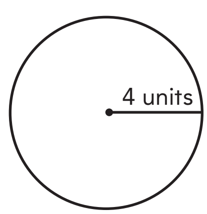
Find the circumference of each circle. Use 3.14 for π.

5.



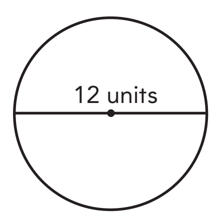
15.7 units

6.



25.12 units

7.



37.72 units

Answer Key

Challenge! Explain the meaning of π in terms of the parts of a circle. How is the circumference of a circle related to π?

Challenge: (Sample) The value of π is the ratio of any circle's circumference to the diameter of the circle.

LESSON 4

Objective

Find the area of a circle.

Common Core State Standards

- **7.G.4** Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

Geometry

Area of a Circle

Measurement concepts are closely related to other mathematics topics, such as geometry and algebra. To develop and conceptualize the formula for the area of a circle, students first estimate the area by tracing a circle on grid paper. Moving the parts of the circle to form a shape that resembles the more-familiar parallelogram helps students justify and internalize the formula.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *Why is the area of the circle written in square centimeters?*
- **Ask:** *What is the relationship between the radius, diameter, circumference, and area of a circle?*
- **Ask:** *How would you find the area of a circle if you know its diameter?*

Solve It

Reread the problem with students. Have students list the information that is needed to find the area of a circle. Then have them explain how to find the area of Maya's rug.

More Ideas

For other ways to teach about the area of a circle—

- Have students use Centimeter Cubes to estimate the area of a circle. Then, using the cubes, have students estimate the radius and diameter of the circle to calculate the area. Tell students to compare the two methods for finding the area of the circle.
- Have students find the area of the circular base of a solid from a set of Relational GeoSolids®. Have students calculate the area two ways, using 3.14 and $\frac{22}{7}$ for π.

Formative Assessment

Have students try the following problem.

The radius of a circle is 10 mi. What is the area of the circle to the nearest whole number?

A. 63 mi

B. 100 sq mi

C. 314 mi

D. 314 sq mi

Try It! 20 minutes | Groups of 4

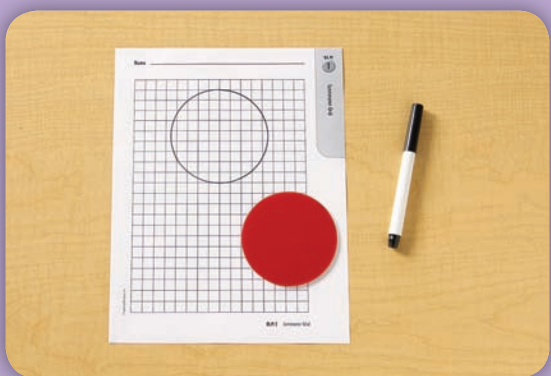
Here is a problem about the area of a circle.

Maya has a circular rug in her bedroom. What is the area of the rug if the radius is 4.4 feet?

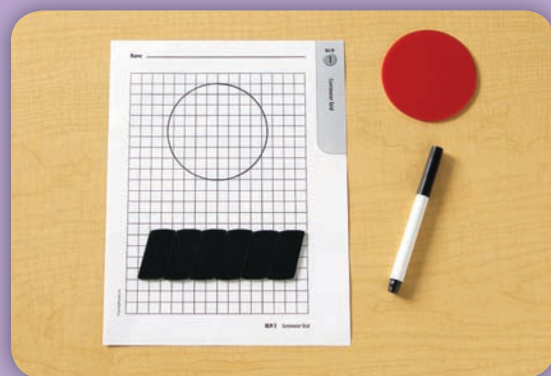
Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials. Review the terms *radius* and *diameter.* Write the symbol π on the board. Have students give the approximate value of π as a fraction and as a decimal.

Materials

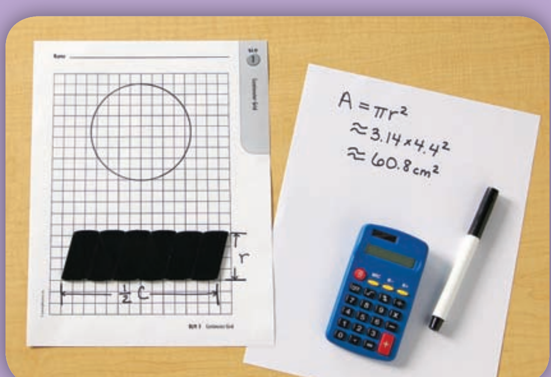
- Deluxe Rainbow Fraction® Circles (1 set per group)
- BLM 1
- paper (1 sheet per group)
- calculators (1 per group)



1. Have students trace the red circle on the grid paper. **Say:** *Estimate the area of the circle by counting the squares and parts of squares.* Have students share their estimates.



2. Guide students to arrange the 12 twelfths in a side-by-side pattern on the grid paper. **Ask:** *What shape does your arrangement resemble?* Write $A = b \times h$ on the board. Have students explain how to find the area of a parallelogram and have them estimate the base, height, and area of the figure.



3. Ask: *What part of a circle is shown by the base of the arrangement? The height?* Show students that the base of the *parallelogram* is roughly $\frac{1}{2}C$ and that the height is roughly *r*. Write the area of the *parallelogram*, $A = \frac{1}{2}C \times r$, on the board. Replace *C* with $2\pi r$ and simplify to get the formula for the area of the circle, $A = \pi r^2$. Have students calculate the area of the red circle using radius 4.4 cm.

Look Out!

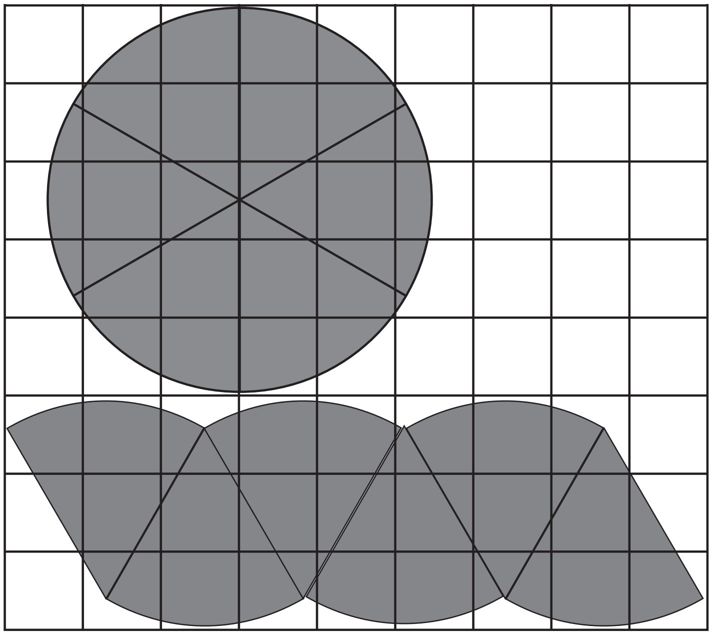
Some students may confuse the radius and the diameter of a circle. Have them draw and label the parts of a circle. Point out that area is always measured in square units, even when the shape has curved sides. Watch for students who think that r^2 means to multiply the length of the radius by two. Review the meaning of exponents with these students.

Answer Key

Use Fraction Circles to model the circle. Use a Centimeter Grid to find the area of the circle.

(Check students' work.)

1.



24 square units

Draw each circle described. Find the area of the circle. Use 3.14 for π.

2. 8-cm radius

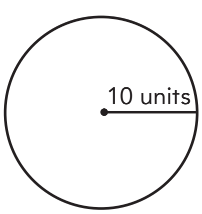
200.96 square cm

3. 2-inch diameter

3.14 square in.

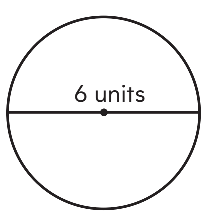
Find the area of each circle. Use 3.14 for π.

4.



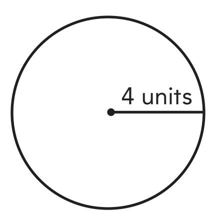
314 square units

5.



28.26 square units

6.



50.24 square units

Answer Key

Challenge! Determine the area of a circle on grid paper by arranging its sections into a figure having a length and width. Describe the length. Describe the width.

Challenge: (Sample) The length of the figure is one-half the circumference because half of the outer edges of the circle make up the edges of the figure. The width of the figure is equal to the radius of the circle.

LESSON 5

Geometry

Area of Irregular Figures

Objective

Determine the area of an irregular figure by dividing it into other shapes, such as rectangles and triangles.

Common Core State Standards

- **7.G.6** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Most of the area problems students are asked to solve in 7th and 8th grade involve combining the areas of standard figures such as squares, rectangles, triangles, and some regular polygons. Finding the area of irregular figures challenges students to build on this knowledge. In addition, having students solve problems of this type can provide teachers with insight into student understanding of area and the formulas used to determine it.

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

Talk About It

Discuss the Try It! activity.

- Help students recognize the rectangle and the two triangles formed when points *ACDF* are connected by the rubber band. **Ask:** *What shapes do you see in this irregular hexagon?*
- Have students discuss how to find the area of the figure now that they see how the figure can be divided into a rectangle and two triangles. **Ask:** *What is the formula for finding the area of a rectangle? A triangle? How can we determine the area of the entire figure?*

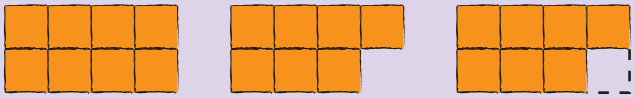
Solve It

Reread the problem with students. If necessary, review what makes a figure regular or irregular. Have students write a short paragraph explaining how it is possible to find the area of an irregular figure by dividing it into its component shapes (rectangles and triangles).

More Ideas

For other ways to teach about the area of irregular figures—

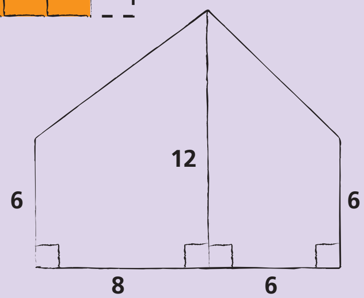
- Have students use the XY Coordinate Pegboard to form irregular figures that have no internal rectangles and divide the figures into triangles.
- Have students make a rectangular figure with the squares from the Pattern Blocks. Instruct them to remove one square from anywhere in the figure. They should then find the area of the resulting irregular figure by thinking of it in terms of the original shape *minus* another shape.



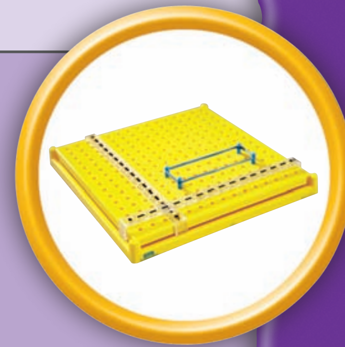
Formative Assessment

Have students try the following problem.

Find the area of the figure.



A. 84 sq. units **B.** 126 sq. units
C. 156 sq. units **D.** 168 sq. units

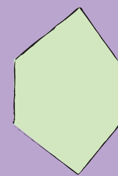


Try It!

35 minutes | Pairs

Here is a problem about the area of irregular figures.

Kristin and Erik want to install new flooring in the sunroom of their grandfather's old house. Unfortunately, the room is oddly shaped. How can they determine the area of such an irregular room?



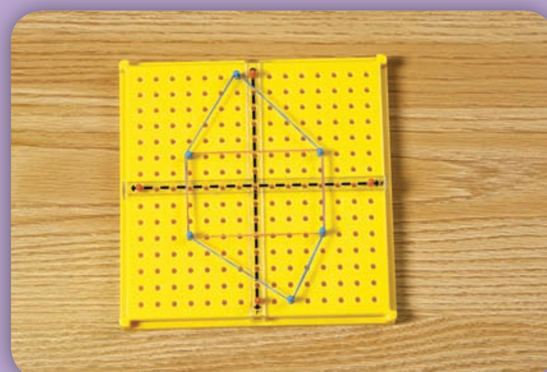
Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials.

Have students set up a four-quadrant grid on their pegboard. Write the following coordinates on the board: *A* (–4, 2), *B* (–1, 7), *C* (4, 2), *D* (4, –3), *E* (2, –7), *F* (–4, –3).

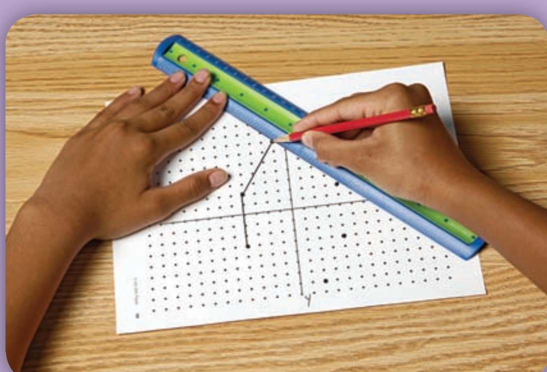
Materials

- XY Coordinate Pegboard
- BLM 10
- ruler or straightedge

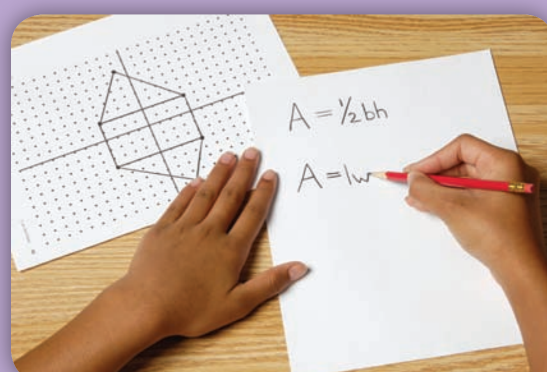
1. Have students place pegs at the coordinates and create figure *ABCDEF*.



2. Have students use a rubber band to connect points *A*, *C*, *D*, and *F* to form a rectangle.



3. Have students transfer the figure to the dot paper by marking and labeling the points. Students should then connect the points with straight lines to form an irregular hexagon.



4. Have students find the area of each of the internal figures—a rectangle and two triangles. Students should then add the areas together to find the total area of the hexagon.

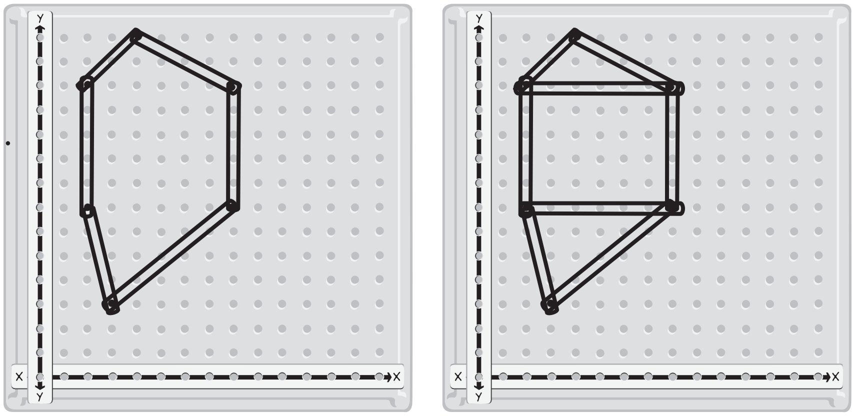
⚠ Look Out!

Be sure that students correctly identify the base and height of the triangles that are found inside the irregular figure. Students should realize that being able to do this is the key to solving problems of this type.

Use an XY Coordinate Pegboard to model the irregular figure. Divide the shape into triangles and a rectangle. Find the area of the irregular figure.

(Check students' work.)

1.



Area

triangle 6 sq units

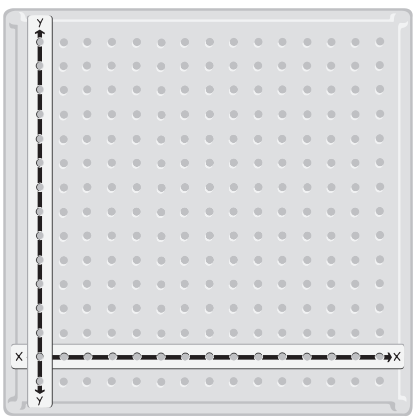
rectangle 30 sq units

triangle 12 sq units

Area of figure 48 sq units

Using an XY Coordinate Pegboard, model an irregular figure. Sketch the model. Find the area of the irregular figure.

2.



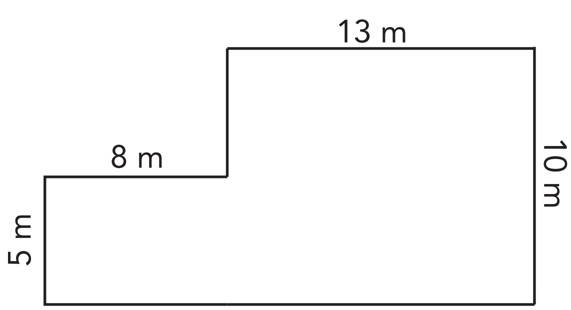
Find the areas of the shapes into which you can divide your figure.

Check students' models; answers will vary depending on models.

Area of figure ________ sq units

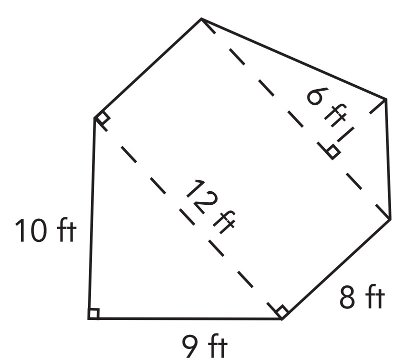
Find the area of each figure.

3.



170 m^2

4.



177 ft^2

Answer Key

Challenge! Why do you divide an irregular figure into other shapes to find its area? Draw a picture to help.

Challenge: (Sample) By dividing an irregular figure into common shapes, you can use formulas you know to find the area. Find the area of each shape and then add the areas together to find the area of the irregular figure.

LESSON 6

Objective

Use various polygons to form a new, larger polygon and measure its area.

Common Core State Standards

- **7.G.6** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Geometry

Polygons: Exploring Area

In the earlier grades, students used concrete objects to measure the area of several different polygons. Students will now learn how to use concrete objects to create polygons with the same area. This skill provides students with a foundation for understanding formulas and concepts that will be introduced later in their mathematics instruction.

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

Talk About It

Discuss the Try It! activity.

- **Ask:** *If two polygons have the same area, will they also have the same perimeter?*
- **Ask:** *Which of the Pattern Blocks can't be used on the triangular grid paper? Explain.*
- **Ask:** *Can you create another polygon with an area of 18 or 24 triangles?*

Solve It

Reread the problem with students. Have them explain how various polygons can have the same area. Encourage students to include sketches in their explanations. Whenever possible, encourage them to use formulas for finding the area of a given polygon.

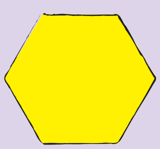
More Ideas

For another way to teach about the area of polygons—

- Have students extend this activity by using Pattern Blocks to create several polygons, each with an area of at least 16 triangular units. Have students then count the number of triangles the shapes cover. Tell students to write the area at the top of their paper. Find several students who have created figures with the same area. Share the drawings with the class.

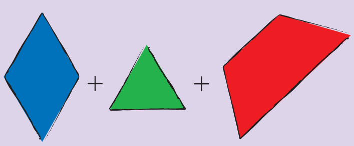
Formative Assessment

Have students try the following problem.

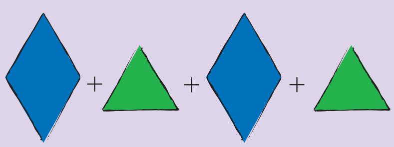


Which set of shapes below will not *have the same area as the figure to the right?*

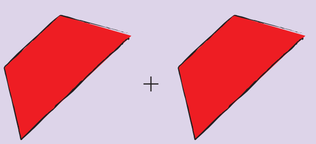
A.



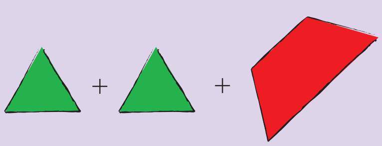
B.



C.



D.



Try It! 30 minutes | Pairs

Here is a problem about finding the area of specific polygons.

Samir is trying to decide which tile pattern to use in the entranceway of his home. He was told that any pattern he chooses must cover exactly 24 triangular units. He has narrowed down his choices to these three patterns:

Pattern #1: A large rhombus made up of three rows consisting of 1 triangle, 1 trapezoid, and 1 rhombus;

Pattern #2: A large parallelogram made up of three rows of 4 rhombuses;

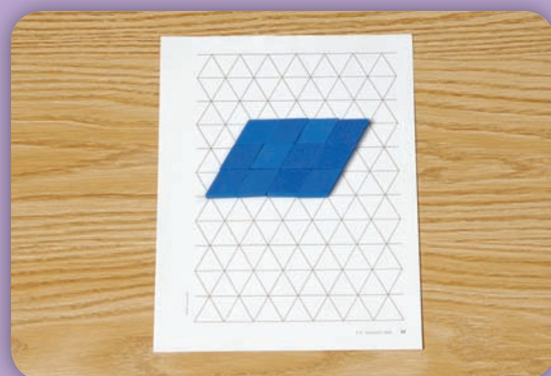
Pattern #3: A large hexagon made up of a small central hexagon surrounded by 6 trapezoids.

Do any of the tile patterns fit the area requirements?

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

Materials
- Pattern Blocks
- BLM 11

1. Have students form a large rhombus consisting of three rows of 1 green triangle, 1 red trapezoid, and 1 blue rhombus as shown. **Ask:** *How many triangles are covered?*



2. Now have students form a large parallelogram using three rows of 4 blue rhombuses. **Ask:** *How many triangles are covered?*

3. Have students form a large hexagon using 1 yellow hexagon and 6 red trapezoids. Have students determine how many triangles are covered. **Ask:** *Is the area the same for all three tile patterns? Do any fit Samir's requirements?*

⚠ Look Out!

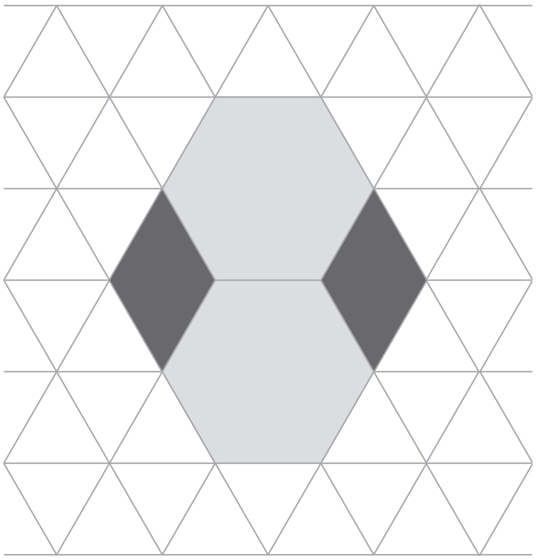
Some students may think that two of the green equilateral triangles together have an area of one square inch. It is a common error since the sides of the triangles each measure 1".
Ask: *What is the formula for the area of a triangle?* Write the formula on the board.
Ask: *What is the base of this triangle?* Elicit "one inch." Students should notice that the height cannot also be 1" if the sloping sides are 1" long. Have students measure the base and height of the triangle if necessary.

Answer Key

Use Pattern Blocks and 1-inch Triangular Grid Paper to build each figure shown. Find the number of triangles covered. Write the area of the figure in triangular units.

(Check students' work.)

1.



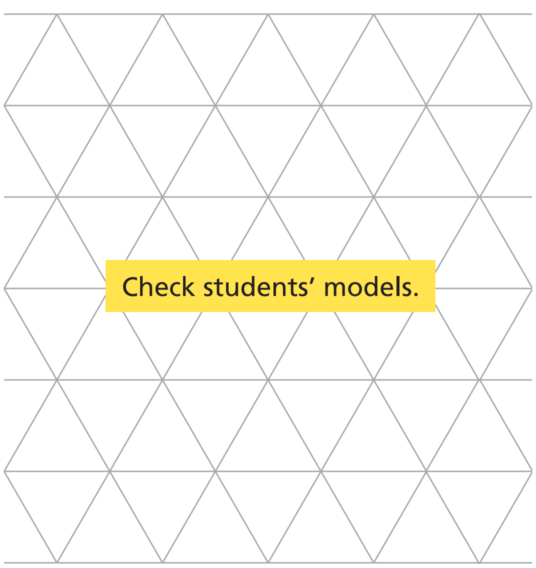
16 triangular units

2.

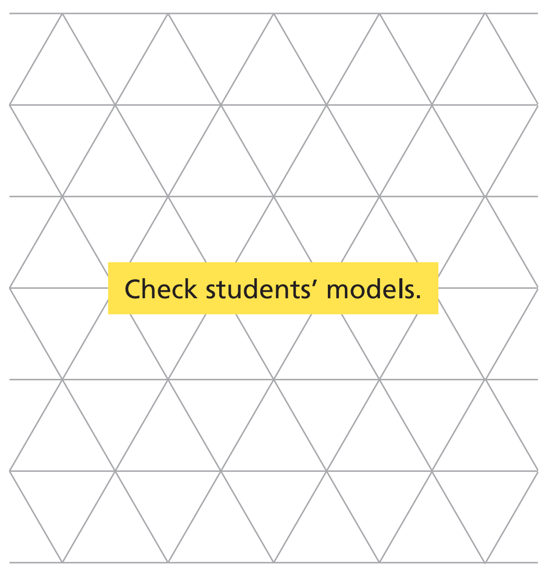
24 triangular units

Using Pattern Blocks and 1-inch Triangular Grid Paper, build a quadrilateral that has each area given. Sketch the model.

3. 20 triangular units



4. 30 triangular units



Answer Key

Challenge! Explain how a hexagon formed using two trapezoids can have the same area as a hexagon formed using six equilateral triangles. Draw a picture to help.

Challenge: (Sample) The area of one trapezoid can be equal to the area of three of the equilateral triangles, so a hexagon formed using two trapezoids can have the same area as a hexagon formed by six equilateral triangles.