



# Geometry

## Circular Thinking: Discovering the Area Formula for Circles Grades 6-7

### Rationale

- ✚ Circles have been studied since ancient times. Today circles are near and far: the wheels on a bicycle and the shape of the sun, small and large: the ring on a finger and the planet we stand on. Circles are an integral part of astronomy and many modern inventions. As such, they have their own unique vocabulary and formulas. In this lesson students will use their knowledge of geometry to discover the formula for the area of a circle. This will enable them to have a clearer understanding of how formulas are developed, thereby firmly planting the information in their geometric knowledge base.

### Goal

- ✚ To understand and remember the formula for the area of a circle

### 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.
- ✚ 6.EE.2.c Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas  $V=s^2$  to find the volume and surface area of a cube with sides of length  $s=1/2$ .*

### Objectives

- ✚ Students will develop the formula for the area of a circle.
- ✚ Students will be able to use a formula to solve real life problems involving circles.

### Materials

- ✚ Scissors
- ✚ *Activity Sheet 1*
- ✚ *Activity Sheet 2*
- ✚ Two crayons, different colors
- ✚ Calculator (optional)

### Procedures

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- ✚ Introduce the lesson telling the students that they will discover the formula for finding the area of a circle.
- ✚ Distribute *Activity Sheet 1* along with 2 different colored crayons to each student.
- ✚ Instruct students to use one crayon to trace the circle and the second crayon to trace the radius.
- ✚ Once that is completed, instruct the students to cut out the circle, making sure to cut just at the outside of the crayon line.
- ✚ Students will now fold the circle in half and in half again making sure the radius is visible. Then cut out the four quarters. One of the quarters should show the radius along the cut line. Then take each quarter circle and fold in fourths. Now cut each quarter into the fourths they have folded.
- ✚ Students should now have 16 wedges. Taking these 16 pieces, arrange them in a rectangle, alternating the pieces: point up, point down, point up, etc. until a rectangle is formed. Students should put the piece with the colored radius first in the row and the colored circumference should be visible.
- ✚ Ask, “What is the formula for the area of a rectangle?” ( $A = bh$ ) “According to your rectangle what part of the circle now forms the height of the rectangle?” (The radius) “What part of the circle forms the base?” (Half of the circumference)
- ✚ Thinking about what has just been discussed, ask pairs of students to work together to use the formula for the area of a rectangle to create a formula for the area of a circle.
- ✚ While students are working, circulate around the room, ask questions to guide them, and challenge them to think through their methods or answers. The students need to know that the circumference is found using  $C = \pi d$ . Since the diameter is  $2r$ , the circumference formula is also  $2\pi r$ . The base is  $\pi r$  because it is half of the circumference, and the height is the radius or  $r$ . Area of a circle  $= \pi r^2$
- ✚ Ask students to share their thoughts, difficulties and answers.
- ✚ Close the lesson by reviewing the formulas for area of a rectangle, the circumference of a circle and the area of a circle. Then have the students practice using their formula to find the area of the circles on *Activity Sheet 2*.

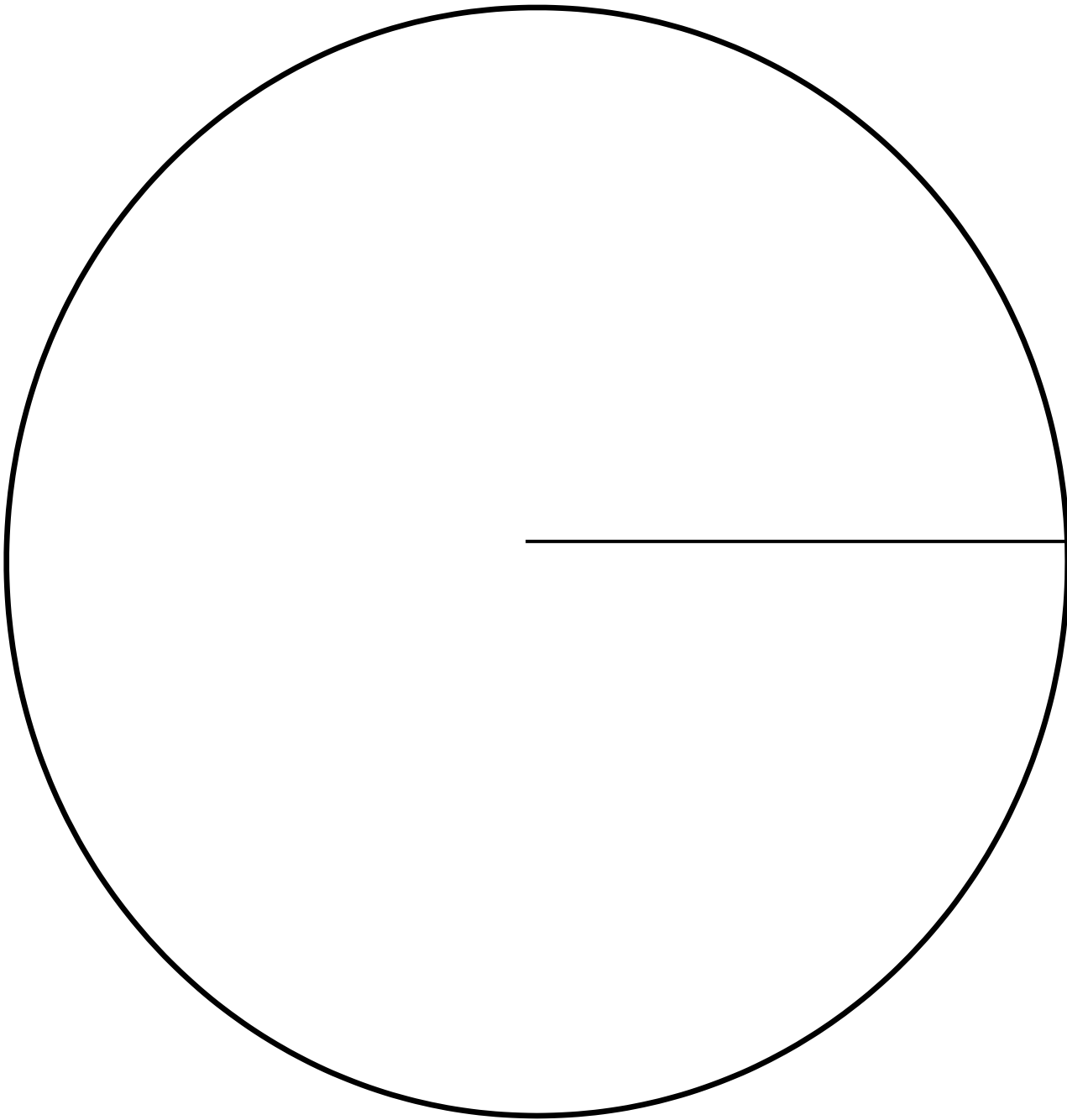
### **Teacher Tips**

- ✚ You may find the folding and cutting will proceed more smoothly if you demonstrate the folding and cutting.
- ✚ While students are working, circulate around the room to make sure that they are arranging the pieces correctly.
- ✚ As you circulate, ask students to explain their methods to you. If their methods are inefficient, or if they’re using the same method all of the time, challenge them to try to do it a different way (without telling or showing them a *specific* method.)
- ✚ The students need to know that the circumference is found using  $C = \pi d$ . Since the diameter is  $2r$ , the circumference formula is also  $2\pi r$ . The base is  $\pi r$  because it is half of the circumference, and the height is the radius or  $r$ . Area of a circle  $= \pi r^2$ .

### **Extension Activities**

- ✚ Have students create a poster naming the various parts of a circle. Have the students research other circle vocabulary: chord, arc, tangent, degree, and quadrant.
- ✚ Have students find the area of the flat half of the earth if cut through the equator. The diameter of the earth at the equator is approximately 7926 miles. Using the formula they have discovered  $A = \pi r^2$  find the area of this surface.
- ✚ Students can research the etymology of the word circle and create a list of words using that root.
- ✚ Using a paper plate, a ruler and the formula, find the area of the plate. This can also be done with various plates or circular lids that students have in their homes.

Activity Sheet 1



## Activity Sheet 2

