

Estimating Areas of Circles

Purpose

Students will estimate areas of circles using two different methods.

Materials

For the teacher: overhead, compass, ruler that can be read on the overhead, large cut out circle (4-inch radius), chalkboard, chalk, tape
For each student: pencil, paper, copy of Black Line Master (BLM)
Estimating Areas of Circles

Activity

A. Class Activity

1. Review areas of squares and rectangles. Remind students of the formula for area of each ($A = s \times s$ and $A = l \times w$).
2. Discuss the area of a circle. Tell students that the area of a circle is the number of square units that can be contained within the circle and that area is always expressed in square units.
3. Explain that since a circle is round in shape, it is difficult to draw squares small enough to fill in the circle. Explain that if it was possible to draw these squares within the circle, it would be possible to find an exact measurement of the area; since that is not possible, there must be another way to approximate the area of a circle.
4. Tell students that one way to figure the approximate area is to draw two squares, one inside the circle and the other outside of it.
5. Draw a circle on the chalkboard. Show students how to draw a square on the outside of the circle so that the edges of the square touch the circle. Show students how to draw a square on the inside of the circle so that the vertices of the square touch the circle. (The example should resemble Figure 1 shown in the "Teacher Directions" on the back of the BLM.)
6. Explain to students that the diameter of the circle, the diagonal of the inner square, and the side of the outer square are all the same length.
7. Label the radius with length r . Explain to students that the length of a side of the large-sized square is two times the length of the radius, or $2 \times r$. (To make this evident, you may need to trace this out on the board using colored chalk.)
8. Say: "If each side of the large square is $2 \times r$, what is the area of the large square?" [$4 \times r \times r$]
9. Instruct the students that the medium-sized square is $\frac{1}{2}$ the size of the large square. Show students how the sides of the

(continued)



INCORPORATING TECHNOLOGY

Have students use a drawing program to create their own circles, print them, cut them out, and measure the diameters. Instruct students to then estimate the area of each circle.



MEETING INDIVIDUAL NEEDS

For students having difficulty visualizing the relationship between the area of the circle and the area of the medium and large squares, prepare individual shapes cut from construction paper. Assemble the individual shapes into the object shown in Figure 1 of "Teacher Directions" on the back of the BLM. Let students take the object apart to gain a better understanding of the relationship.

Standards Links 6.1.6, 6.5.1

Activity (continued)




- medium-sized square are diagonals of the four small-sized squares and divide them in half.
- Ask: “If the area of the large-sized square is $4 \times r \times r$, then what is the area of the medium-sized square?” [$2 \times r \times r$]
 - Explain to students that since the circle lies between the large and medium-sized square, we can estimate the area of the circle by finding the average of the areas of the large and medium-sized squares. Ask students to tell you the average of $4 \times r \times r$ and $2 \times r \times r$. [$3 \times r \times r$] Tell students that $3 \times r \times r$ is a good estimate of the area of a circle.
 - Explain to students that a second way to estimate the area of a circle is to transform the circle into a rectangle. Have students shade in $\frac{1}{2}$ of the cut-out circle. Have students cut the circle into at least eight equal wedges as shown in Figure 2 of “Teacher Directions.”
 - Tell students to attach the wedges together using tape to form a quadrilateral with width r (radius of original circle) and length equal to half of the circumference of the original circle. The shape will resemble a rectangle as the size of the wedges is decreased.
 - Ask students to write the area of the rectangle in terms of r . (Note: See Standard 5/Activity 2 for an explanation of estimating the circumference.) Remind students that the circumference is about $3 \times d$, or $3 \times 2 \times r$. Say: “The area of the rectangle is $\frac{1}{2}$ the circumference times the radius.”
 - Write the following on the board: “Area of rectangle is about $\frac{1}{2}$ ($3 \times 2 \times r$) $\times r$, or $3 \times r \times r$.”
 - Remind students that area is expressed in square units. Ask students to use $3 \times r \times r$ to estimate areas of circles with the following radii: 1 in [3 in^2], 6 cm [108 cm^2], 2 mm [12 mm^2].

B. Individual Activity

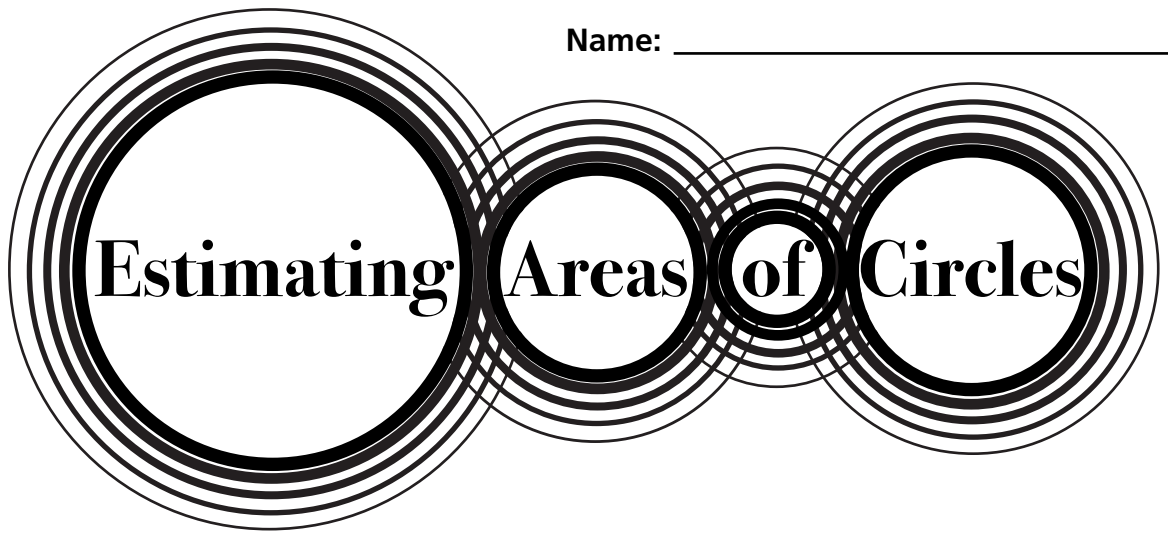
- Hand out one copy of the BLM *Estimating Areas of Circles* to each student.
- Allow ample time to complete the activity and discuss results with the class.

Classroom Assessment**Basic Concepts and Processes**

When reviewing the BLM, discuss the following questions with students to gauge their understanding of the Standard Indicators:

-  Explain the difference between the circumference and area of a circle.
-  If the diameter of a circle is 2 m, what would be a good estimate of the area of that circle?
-  How did you compute your answer?

Name: _____

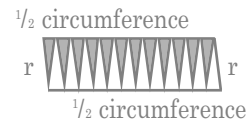
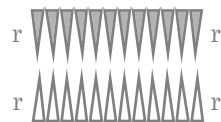


Diameter of circle	Radius of circle	Estimated area of circle
	3 in	
8 cm		
		75 mm ²
		363 yd ²
	10 mi	
100 km		
16 ft		
		1,200 m ²
		243 in ²
	7 cm	

Estimating Areas of Circles

Teacher Directions

Explain how to estimate the area of circles by using the following diagrams:



Distribute one copy of the BLM *Estimating Areas of Circles* to each student. Ask students to complete the table based on the given information. Remind students to label solutions with the proper unit of measurement.

Answer Key

Diameter of circle	Radius of circle	Estimated area of circle
6 in	3 in	27 in ²
8 cm	4 cm	48 cm ²
10 mm	5 mm	75 mm ²
22 yd	11 yd	363 yd ²
20 mi	10 mi	300 mi ²
100 km	50 km	7,500 km ²
16 ft	8 ft	192 ft ²
40 m	20 m	1,200 m ²
18 in	9 in	243 in ²
14 cm	7 cm	147 cm ²