WARM UP
Determine the area of each circle. Use 3.14 for π.

1. 4 in.
2. 3.8 cm
3. 9 m
4. 12 ft

LEARNING GOALS
• Use the area and circumference formulas for a circle to solve problems.
• Calculate the areas of composite figures.

You encounter circles regularly in life. Now that you know how to calculate the circumference and area of circles, what kind of problems can you solve?
A Winning Formula

Suppose that the circumference of a circle is approximately 157 centimeters.

1. Describe a strategy you can use to solve for the area of the circle.

When in doubt, use 3.14 for pi throughout this lesson.

2. Solve for the area of the circle. Use 3.14 for $\pi$. 
A friend gave you 120 feet of fencing. You decide to fence in a portion of the backyard for your dog. You want to maximize the amount of fenced land.

1. Draw a diagram, label the dimensions, and compute the maximum fenced area. Assume the fence is free-standing and you are not using any existing structure.
In previous grades you worked with composite figures made up of triangles and various quadrilaterals. Now that you know the area of a circle, you can calculate the area of more interesting composite figures.

1. A figure is composed of a rectangle and two semicircles. Determine the area of the figure.

   - A semicircle is half of a circle.

2. A figure is composed of a trapezoid and a semicircle. Determine the area of the figure.

3. A figure is composed of a triangle and three semicircles. Determine the area of the figure.
You have worked with composite figures by adding on areas. Now let’s think about subtracting areas.

1. In the concentric circles shown, \( R \) represents the radius of the larger circle and \( r \) represents the radius of the smaller circle. Suppose that \( R = 8 \) centimeters and \( r = 3 \) centimeters. Calculate the area of the shaded region.

![Concentric circles diagram]

2. A circle is inscribed in a square. Determine the area of the shaded region.

![Inscribed circle in square diagram]
3. Two small circles are drawn that touch each other, and both circles touch the large circle. Determine the area of the shaded region.

![Diagram of two small circles touching each other and a large circle]

4. Jimmy and Matthew each said the area of the shaded region is about 402 square inches. Compare their strategies.

**Jimmy**

Area of 1 small circle
A ≈ 3.14(8)²
A ≈ 3.14(64)
A ≈ 200.96

Area of 2 small circles
A ≈ 2(200.96)
A ≈ 401.92

Area of large circle
A ≈ (3.14)(16)²
A ≈ (3.14)(256)
A ≈ 803.84

Area of shaded region
803.84 − 401.92 ≈ 401.92

The area of the shaded region is about 402 sq in.

**Matthew**

Area of 1 small circle
A = \pi(8)²
A = 64\pi

Area of 2 small circles
A = 2(64\pi)
A = 128\pi

Area of large circle
A = \pi(16)²
A = 256\pi

Area of shaded region
256\pi − 128\pi = 128\pi
A = 128\pi
A ≈ 402.12

This means the area of the shaded region is about 402 sq in.
a. What did Jimmy and Matthew do the same?

b. What was different about their strategies?

c. Which strategy do you prefer?

5. Determine the area of each shaded region.

a. One medium circle and one small circle touch each other, and each circle touches the large circle.

b. A rectangle is inscribed in a circle.

c. A circle is inside a regular hexagon.
Rupert’s Leash

Jamal loves his dog, Rupert. On sunny days, Jamal keeps Rupert on a 12-foot leash in the backyard. The leash is secured to a stake in the ground.

1. Determine the diameter, circumference, and area of Rupert’s play area. Use 3.14 for \( \pi \).

2. Suppose Jamal wants to give Rupert a little more room to play. He uses a 15-foot leash instead of the 12-foot leash. What is the area of Rupert’s play area now? Use 3.14 for \( \pi \).
Practice
Calculate the area of the shaded region in each figure. Use 3.14 for π and round to the nearest tenth, if necessary.

1. 
   - Radius = 2.5 cm
   - Diameter = 5 cm
   - Area of circle = \( \pi r^2 = \pi (2.5)^2 = 19.625 \) cm²
   - Area of rectangle = \( 10 \times 10 = 100 \) cm²
   - Area of shaded region = \( 100 - 19.625 = 80.375 \) cm²

2. 
   - Diameter = 10 cm
   - radius = 5 cm
   - Area of circle = \( \pi r^2 = \pi (5)^2 = 78.5 \) cm²
   - Area of rectangle = \( 5 \times 4 = 20 \) cm²
   - Area of shaded region = \( 78.5 - 20 = 58.5 \) cm²

3. 
   - Diameter = 6 cm
   - radius = 3 cm
   - Area of circle = \( \pi r^2 = \pi (3)^2 = 28.26 \) cm²
   - Area of shaded region = \( 10 - 28.26 = -18.26 \) cm²

4. 
   - Diameter = 16 cm
   - radius = 8 cm
   - Area of circle = \( \pi r^2 = \pi (8)^2 = 201.06 \) cm²
   - Area of shaded region = \( 201.06 - 12 = 189.06 \) cm²

Write
Write the area and circumference formulas for circles.

Describe \( \pi \) in terms of the area and radius of a circle. Describe \( \pi \) in terms of the circumference and radius of a circle.

Remember
Given a specific length to form a perimeter or circumference, arranging that length into the shape of a circle provides the maximum area.
**Stretch**

1. Determine the area of the shaded region. All circles have the same radius of 10 inches.

![Diagram of four circles with a shaded region in the center]

**Review**

Solve each problem.

1. Jose is adding mulch to an existing round flower bed. The length of the rubber edging around the flower bed is 25.12 feet. What is the area that Jose needs to cover with mulch?

2. Nami is adding a mosaic pattern to the top of a small round table. The distance around the edge of the table top is 4.7 feet. What is the area that Nami needs to cover with the mosaic pattern?

Determine each area.

3. Area of a triangle with a base length of 4 in. and a height of 9 in.

4. Area of a parallelogram with a base length of 2.9 ft and a height of 5.5 ft.

5. Area of a trapezoid with a top base length of 6 cm, a bottom base length of 12 cm, and a height of 5 cm.

Write a unit rate for each ratio.

6. \[
\frac{28 \text{ cm}}{4 \text{ square feet}}
\]

7. \[
\frac{5.15 \text{ yd}}{5 \text{ square feet}}
\]