Essential Question How can you find the area of a circle?
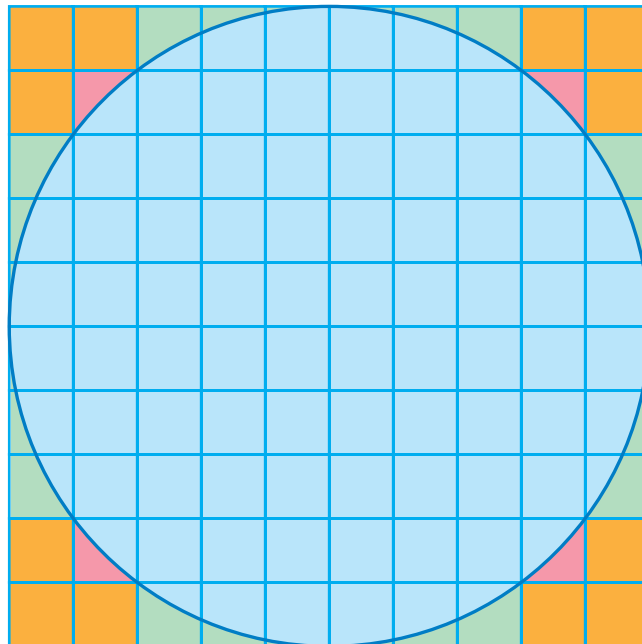
1 ACTIVITY: Estimating the Area of a Circle

Work with a partner. Each square in the grid is 1 unit by 1 unit.

a. Find the area of the large 10-by-10 square.

b. Copy and complete the table.

Region			
Area			

c. Use your results to approximate the area of the circle. Explain your reasoning.

d. Fill in the blanks. Explain your reasoning.
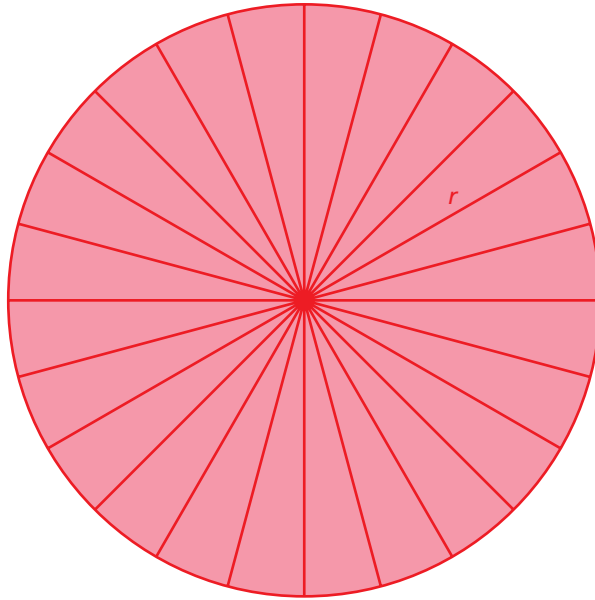
$$\text{Area of large square} = \boxed{} \cdot 5^2$$

$$\text{Area of circle} = \boxed{} \cdot 5^2$$
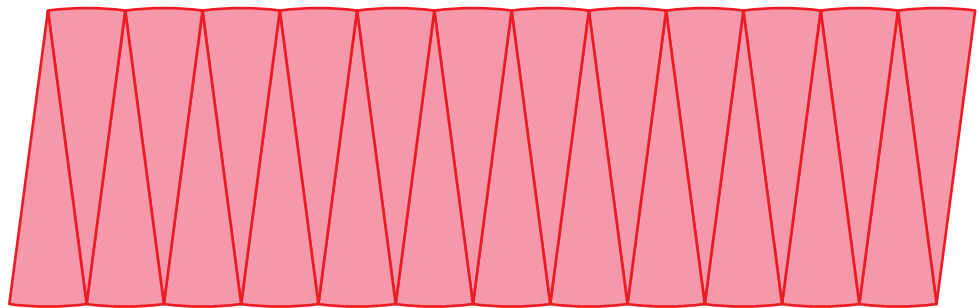
e. What can you conclude?

ACTIVITY: Approximating the Area of a Circle

Work with a partner.

a. Draw a circle. Label the radius as r.

b. Divide the circle into 24 equal sections.

c. Cut the sections apart. Then arrange them to approximate a parallelogram.

d. What is the approximate height and base of the parallelogram?

e. Find the area of the parallelogram. What can you conclude?

What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you find the area of a circle?

4. Write a formula for the area of a circle with radius r. Find an object that is circular. Use your formula to find the area.

Practice

Use what you learned about areas of circles to complete Exercises 3–5 on page 258.
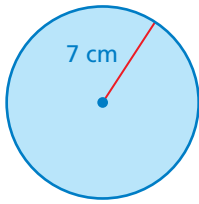
🔑 Key Idea

Area of a Circle

Words The area A of a circle is the product of π and the square of the radius.

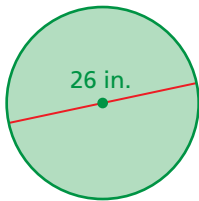**Numbers** $A = \pi r^2$

EXAMPLE 1 Finding Areas of Circles

a. Find the area of the circle. Use $\frac{22}{7}$ for π.

7 cm

Estimate $3 \times (7)^2 \approx 3 \times 50 = 150$

$A = \pi r^2$ Write formula for area.

$\approx \frac{22}{7} \cdot (7)^2$ Substitute $\frac{22}{7}$ for π and 7 for r.

$= \frac{22}{\cancel{7}_1} \cdot \cancel{49}^{7}$ Evaluate $(7)^2$. Divide out the common factor.

$= 154$ Multiply.

∴ The area is about 154 square centimeters.

Reasonable? $154 \approx 150$ ✓

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

26 in.

The radius is $26 \div 2 = 13$ inches.

Estimate $3 \times (13)^2 \approx 3 \times 170 = 510$

$A = \pi r^2$ Write formula for area.

$\approx 3.14 \cdot (13)^2$ Substitute 3.14 for π and 13 for r.

$= 3.14 \cdot 169$ Evaluate $(13)^2$.

$= 530.66$ Multiply.

∴ The area is about 530.66 square inches.

Reasonable? $530.66 \approx 510$ ✓

🔴 On Your Own

Now You're Ready
Exercises 3–12

1. Find the area of a circle with a radius of 6 feet. Use 3.14 for π.

2. Find the area of a circle with a diameter of 28 meters. Use $\frac{22}{7}$ for π.

You want to find the distance the monster truck travels when the tires make one 360-degree rotation. Which best describes this distance?

- Ⓐ the radius of the tire
- Ⓑ the diameter of the tire
- Ⓒ the circumference of the tire
- Ⓓ the area of the tire

The distance the truck travels after one rotation is the same as the distance *around* the tire. So, the circumference of the tire best describes the distance in one rotation.

∴ The correct answer is Ⓒ.

On Your Own

3. You want to find the height of one of the tires. Which measurement would best describe the height?

EXAMPLE ③ **Finding the Area of a Semicircle**
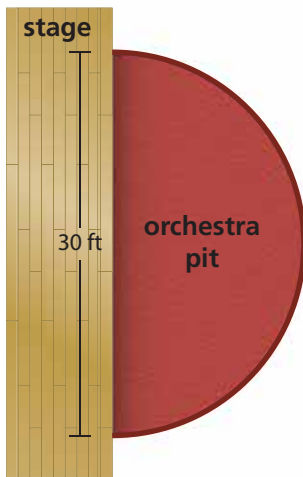
Find the area of the semicircular orchestra pit.

stage
30 ft
orchestra pit

The area of the orchestra pit is one-half the area of a circle with a diameter of 30 feet.

The radius of the circle is $30 \div 2 = 15$ feet.

$$\frac{A}{2} = \frac{\pi r^2}{2}$$ Divide the area by 2.

$$\approx \frac{3.14 \cdot (15)^2}{2}$$ Substitute 3.14 for π and 15 for r.

$$= \frac{3.14 \cdot 225}{2}$$ Evaluate $(15)^2$.

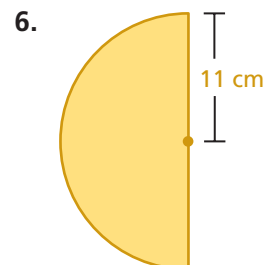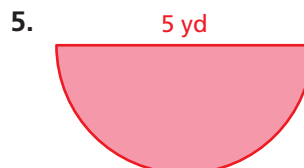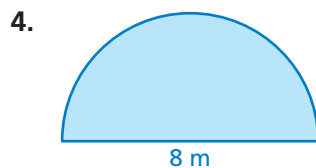$$= 353.25$$ Simplify.

∴ The area of the orchestra pit is about 353.25 square feet.

On Your Own

Now You're Ready
Exercises 13–15

Find the area of the semicircle.

4.

8 m

5.

5 yd

6.

11 cm

Vocabulary and Concept Check

1. **VOCABULARY** Explain how to find the area of a circle given its diameter.

2. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

What is the area of a circle with a diameter of 1 m?

What is the area of a circle with a diameter of 100 cm?

What is the area of a circle with a radius of 100 cm?

What is the area of a circle with a radius of 500 mm?

Practice and Problem Solving

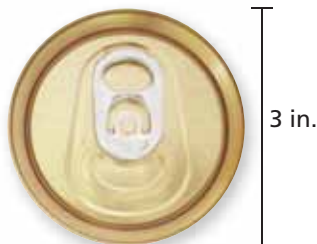Find the area of the circle. Use 3.14 or $\frac{22}{7}$ for π.

① 3.
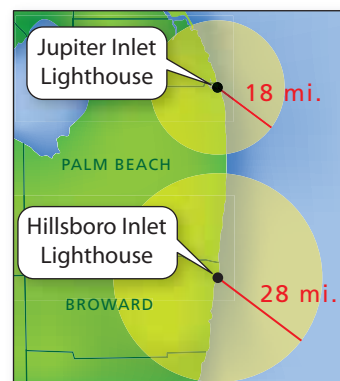9 mm

4.
14 cm

5.
10 in.

**6.**
3 in.

7.
2 cm

8.
1.5 ft

9. Find the area of a circle with a diameter of 56 millimeters.

10. Find the area of a circle with a radius of 5 feet.

11. **PIZZA** The diameter of a pizza is 16 inches. What is the area?

12. **LIGHTHOUSE** The Hillsboro Inlet Lighthouse lights up how much more area than the Jupiter Inlet Lighthouse?
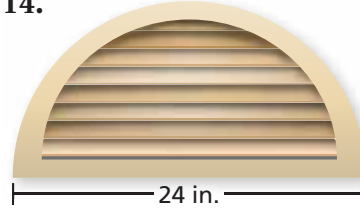
Jupiter Inlet Lighthouse
18 mi.
PALM BEACH
Hillsboro Inlet Lighthouse
28 mi.
BROWARD

Find the area of the semicircle.

13.

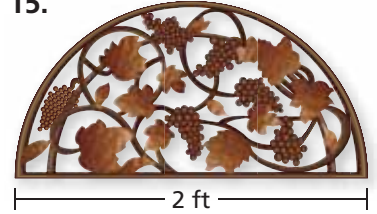|—— 40 cm ——|

14.

|—— 24 in. ——|

15.

|—— 2 ft ——|
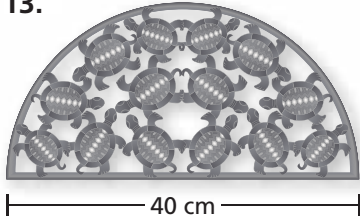
16. REASONING Consider five circles with radii of 1, 2, 4, 8, and 16 inches.

  a. Copy and complete the table. Write your answer in terms of π.

  b. Compare the areas and circumferences. What happens to the circumference of a circle when you double the radius? What happens to the area?

  c. What happens when you triple the radius?

| Radius	Circumference	Area
1	2π in.	π sq. in.
2		
4		
8		
16		
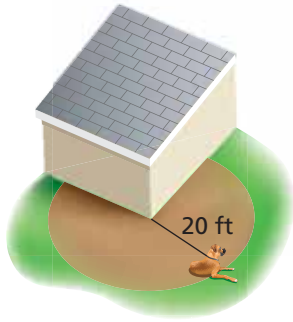
17. DOG A dog is leashed to the corner of a house. How much running area does the dog have? Explain how you found your answer.
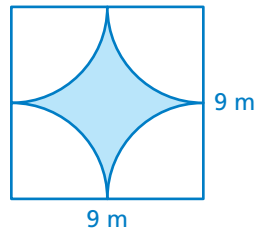
20 ft

18. CRITICAL THINKING Is the area of a semicircle with a diameter of x *greater than*, *less than*, or *equal to* the area of a circle with a diameter of $\frac{1}{2}x$? Explain.

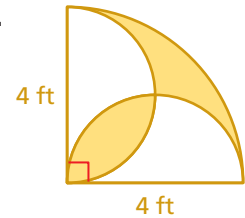**Reasoning** Find the area of the shaded region. Explain how you found your answer.

19.

5 in.

20.

9 m

9 m

21.

4 ft

4 ft
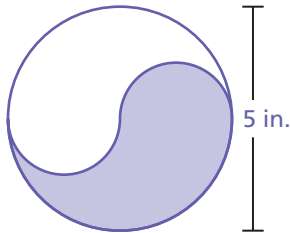
Fair Game Review What you learned in previous grades & lessons

Evaluate the expression.

22. $\frac{1}{2}(7)(4) + 6(5)$

23. $\frac{1}{2} \cdot 8^2 + 3(7)$

24. $12(6) + 3.14 \cdot 2^2$

25. MULTIPLE CHOICE What is the product of $8\frac{1}{3}$ and $3\frac{2}{5}$?

  Ⓐ $2\frac{23}{51}$ Ⓑ $4\frac{1}{5}$ Ⓒ $24\frac{2}{15}$ Ⓓ $28\frac{1}{3}$