Student Guide

Explore Circumference and Diameter (SG pp. 552–558) Questions 1–26

1. **A.*** Answers may vary. Possible responses: The circumference can be measured by laying string, yarn, ribbon, or wire around the circumference and then measuring its length, or using a sewing tape measure or other tape measure that bends.

   B.* Answers may vary. Possible responses: The diameter can be measured with a ruler or by using a string and then measuring its length. The measurement of the diameter goes through the center point of the circle.

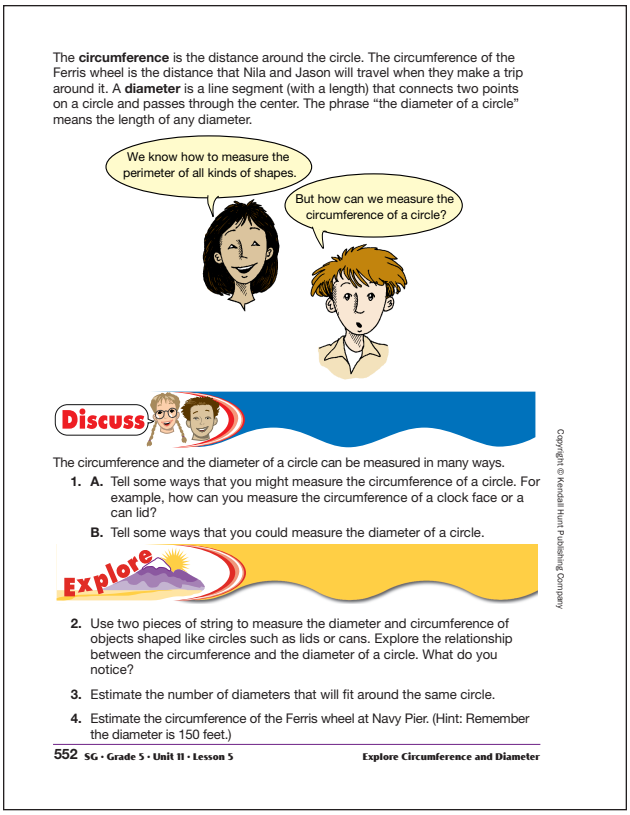
2.* Answers will vary. There are always about 3 diameters in the circumference of a circle.

3.* About 3

4.* The estimate circumference of the Ferris wheel $\approx 3 \times 150 = 450$ feet.

5.* See discussion of ***Question 5*** in the lesson.

6.* See Figure 4 in Lesson for a sample picture.



The **circumference** is the distance around the circle. The circumference of the Ferris wheel is the distance that Nila and Jason will travel when they make a trip around it. A **diameter** is a line segment (with a length) that connects two points on a circle and passes through the center. The phrase "the diameter of a circle" means the length of any diameter.

Discuss

The circumference and the diameter of a circle can be measured in many ways.

1. **A.** Tell some ways that you might measure the circumference of a circle. For example, how can you measure the circumference of a clock face or a can lid?
   B. Tell some ways that you could measure the diameter of a circle.

Explore

2. Use two pieces of string to measure the diameter and circumference of objects shaped like circles such as lids or cans. Explore the relationship between the circumference and the diameter of a circle. What do you notice?
3. Estimate the number of diameters that will fit around the same circle.
4. Estimate the circumference of the Ferris wheel at Navy Pier. (Hint: Remember the diameter is 150 feet.)

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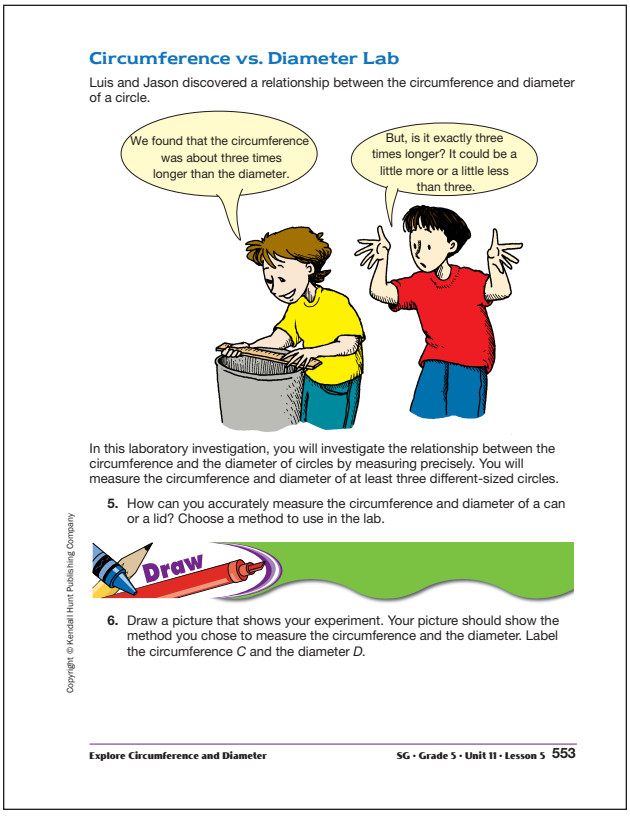

Circumference vs. Diameter Lab

Luis and Jason discovered a relationship between the circumference and diameter of a circle.

In this laboratory investigation, you will investigate the relationship between the circumference and the diameter of circles by measuring precisely. You will measure the circumference and diameter of at least three different-sized circles.

5. How can you accurately measure the circumference and diameter of a can or a lid? Choose a method to use in the lab.

Draw

6. Draw a picture that shows your experiment. Your picture should show the method you chose to measure the circumference and the diameter. Label the circumference *C* and the diameter *D*.

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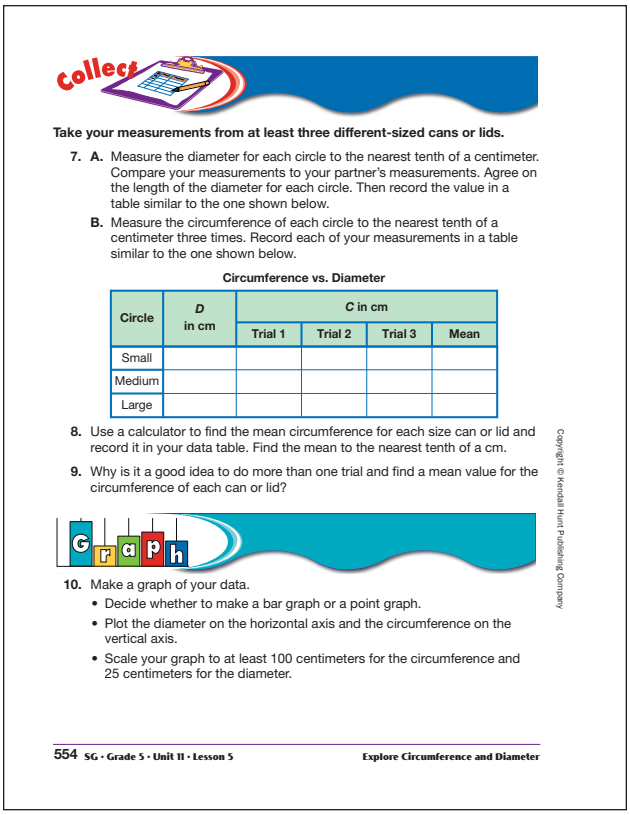
***Answers and/or discussion are included in the lesson.**



Collect

Take your measurements from at least three different-sized cans or lids.

7. **A.** Measure the diameter for each circle to the nearest tenth of a centimeter. Compare your measurements to your partner's measurements. Agree on the length of the diameter for each circle. Then record the value in a table similar to the one shown below.
   B. Measure the circumference of each circle to the nearest tenth of a centimeter three times. Record each of your measurements in a table similar to the one shown below.

Circumference vs. Diameter

Circle	*D* in cm	*C* in cm			
		Trial 1	Trial 2	Trial 3	Mean
Small					
Medium					
Large					

8. Use a calculator to find the mean circumference for each size can or lid and record it in your data table. Find the mean to the nearest tenth of a cm.
9. Why is it a good idea to do more than one trial and find a mean value for the circumference of each can or lid?

Graph

10. Make a graph of your data.
   - Decide whether to make a bar graph or a point graph.
   - Plot the diameter on the horizontal axis and the circumference on the vertical axis.
   - Scale your graph to at least 100 centimeters for the circumference and 25 centimeters for the diameter.

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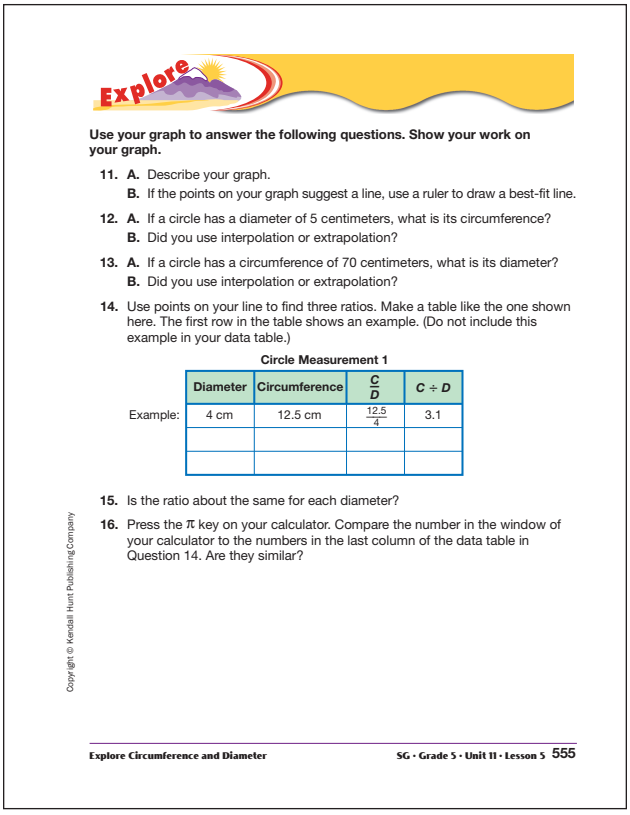

Explore

Use your graph to answer the following questions. Show your work on your graph.

11. **A.** Describe your graph.
   B. If the points on your graph suggest a line, use a ruler to draw a best-fit line.
12. **A.** If a circle has a diameter of 5 centimeters, what is its circumference?
   B. Did you use interpolation or extrapolation?
13. **A.** If a circle has a circumference of 70 centimeters, what is its diameter?
   B. Did you use interpolation or extrapolation?
14. Use points on your line to find three ratios. Make a table like the one shown here. The first row in the table shows an example. (Do not include this example in your data table.)

Circle Measurement 1

	Diameter	Circumference	$\frac{C}{D}$	$C \div D$
Example:	4 cm	12.5 cm	$\frac{12.5}{4}$	3.1

15. Is the ratio about the same for each diameter?
16. Press the π key on your calculator. Compare the number in the window of your calculator to the numbers in the last column of the data table in Question 14. Are they similar?

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7–8.* Answers will vary. See Figure 5 in the lesson for a sample data table.

9.* Finding the mean value helps to eliminate some of the experimental error in measuring the circumference of the circles.

10.* See Figure 6 in the lesson for a sample graph.

11. A.* The points fall in a straigth, up hill line.

B.* See Figure 6 in the lesson.

12. A.* About 15 centimeters. See Figure 6 in the lesson, which shows interpolation on the sample graph.

B. Interpolation

13. A.* 22 centimeters. See Figure 6 in the lesson, which shows extrapolation on the sample graph.

B. Extrapolation

14.* See Figure 7 in the lesson for a sample data table. **15.*** Ratios should be about the same.

16. The number in the calculator window should be close to the students' numbers in the last column of their data table in ***Question 14.***

***Answers and/or discussion are included in the lesson.**

17. A.

Circle Measurement 2

Diameter	Circumference	$\frac{C}{D}$	$C \div D$
8 cm	25.13 cm	$\frac{25.13}{8}$	3.14
10 cm	31.42 cm	$\frac{31.42}{10}$	3.14
26 cm	81.68 cm	$\frac{81.68}{26}$	3.14
3.82 cm	12 cm	$\frac{12}{3.82}$	3.14
1.91 cm	6 cm	$\frac{6}{1.91}$	3.14

B. $D = C \div \pi$

C. $C = D \times \pi$

18. A. $C = 20 \times 3 = 60$ cm

B. $20 \times 3.14 = 62.8$ cm

C. $20 \times \pi = 62.83185307$. Using 3.14 gives a much closer estimate than using 3. Using the π key on the calculator gives a very accurate answer.

19. A. $24.5 \text{ cm} \times \pi \approx 77.0$ cm

B. $48 \div \pi \approx 15.3$ cm

20. $D = 3$ inches

21. $C = 273.3$ cm

22.

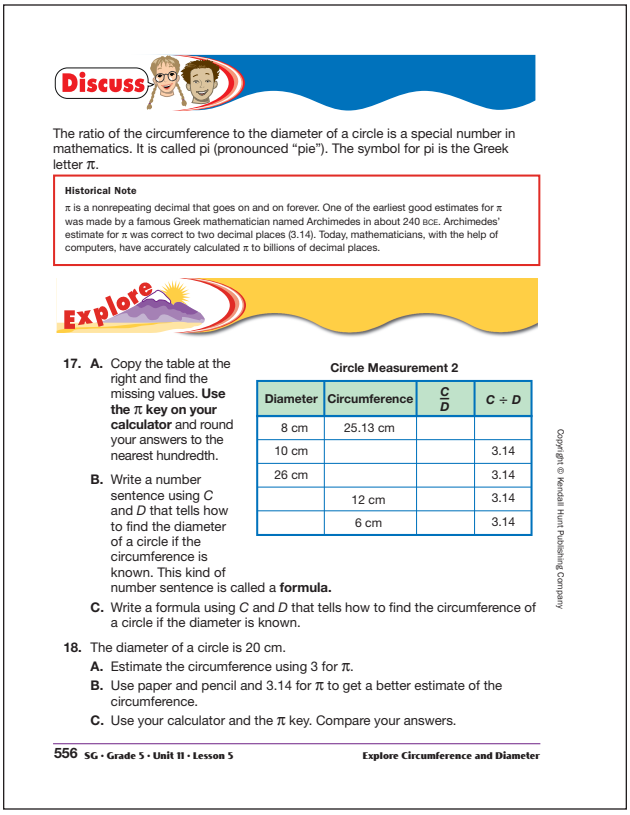
Circle Measurement 3

D	C
15 cm	47.1 cm
30 cm	94.2 cm
4.46 cm	14 cm
19.10 cm	60 cm

23 A. About 135 cm

B. About 223 cm

C. About 223 cm



Discuss

The ratio of the circumference to the diameter of a circle is a special number in mathematics. It is called pi (pronounced "pie"). The symbol for pi is the Greek letter π.

Historical Note

π is a nonrepeating decimal that goes on and on forever. One of the earliest good estimates for π was made by a famous Greek mathematician named Archimedes in about 240 BCE. Archimedes' estimate for π was correct to two decimal places (3.14). Today, mathematicians, with the help of computers, have accurately calculated π to billions of decimal places.

Explore

17. A. Copy the table at the right and find the missing values. **Use the π key on your calculator** and round your answers to the nearest hundredth.

Circle Measurement 2

Diameter	Circumference	$\frac{C}{D}$	$C \div D$
8 cm	25.13 cm		
10 cm			3.14
26 cm			3.14
	12 cm		3.14
	6 cm		3.14

B. Write a number sentence using *C* and *D* that tells how to find the diameter of a circle if the circumference is known. This kind of number sentence is called a **formula.**

C. Write a formula using *C* and *D* that tells how to find the circumference of a circle if the diameter is known.

18. The diameter of a circle is 20 cm.

A. Estimate the circumference using 3 for π.

B. Use paper and pencil and 3.14 for π to get a better estimate of the circumference.

C. Use your calculator and the π key. Compare your answers.

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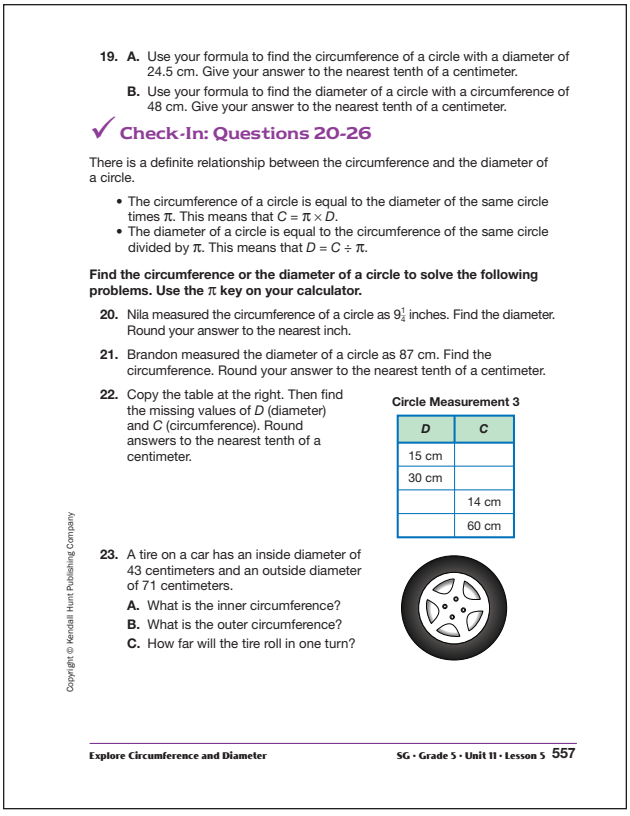

19. A. Use your formula to find the circumference of a circle with a diameter of 24.5 cm. Give your answer to the nearest tenth of a centimeter.

B. Use your formula to find the diameter of a circle with a circumference of 48 cm. Give your answer to the nearest tenth of a centimeter.

✓ Check-In: Questions 20-26

There is a definite relationship between the circumference and the diameter of a circle.

- The circumference of a circle is equal to the diameter of the same circle times π. This means that $C = \pi \times D$.
- The diameter of a circle is equal to the circumference of the same circle divided by π. This means that $D = C \div \pi$.

Find the circumference or the diameter of a circle to solve the following problems. Use the π key on your calculator.

20. Nila measured the circumference of a circle as $9\frac{1}{4}$ inches. Find the diameter. Round your answer to the nearest inch.

21. Brandon measured the diameter of a circle as 87 cm. Find the circumference. Round your answer to the nearest tenth of a centimeter.

22. Copy the table at the right. Then find the missing values of *D* (diameter) and *C* (circumference). Round answers to the nearest tenth of a centimeter.

Circle Measurement 3

D	C
15 cm	
30 cm	
	14 cm
	60 cm

23. A tire on a car has an inside diameter of 43 centimeters and an outside diameter of 71 centimeters.

A. What is the inner circumference?

B. What is the outer circumference?

C. How far will the tire roll in one turn?

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In Questions 24–26, round all answers to the nearest centimeter or inch. Estimate to see if your answers are reasonable. Include labels.

24. A bicycle wheel rolls 75 inches with one turn of the wheel. What is the diameter of the wheel to the nearest inch?

25. It takes 30 fifth graders, arms outstretched, to surround a Giant Sequoia tree. Estimate the tree's diameter. (Hin: An average fifth-grader's arm span is about 140 cm.)

26. One wheel on Frank's chair has a diameter of 64 centimeters. If he goes to the store and back, a distance of 3000 meters, about how many turns does the wheel make?

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Homework

Professor Peabody was having fun exploring different numbers for the circumference and the diameter of circles on his calculator. Use the π the key on your calculator to solve the problems.

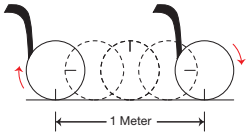
1. Find the circumference of a circle that has a diameter of 3367 inches. Round your answer to the nearest inch.
2. Find the diameter of a circle that has a circumference of 82,771 inches. Round your answer to the nearest inch.

First estimate in your head. Then use your calculator to find a better estimate of the diameter for the circles with circumferences listed in Questions 3 and 4. Round your answer to the nearest tenth of a unit.

3. C = 942 units
4. C = 8075 units

First estimate in your head. Then use your calculator to find a better estimate of the circumference for the diameters listed in Questions 5 and 6. Round your answer to the nearest tenth of a unit.

5. D = 9460 units
6. D = 5977.6 units
7. A trundle wheel is a disk that rolls along the ground and clicks once every time it makes a complete turn. It is often used for surveying land. What is the diameter of a trundle wheel that clicks once every meter? Round your answer to the nearest hundredth of a meter.



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24.* 24 inches

25.* 140 × 30 = 4200 cm; 4200 ÷ π = 1337 cm

26.* About 1492 turns; 64 × π ≈ 201 cm;
3000 meters = 300,000 cm;
300,000 ÷ 201 ≈ 1492.5

Homework (SG p. 559)
Questions 1–7

1. 10,578 inches
2. 26,347 inches
3. Since C is close to 900, and circumference is about 3 times the diameter, we can estimate the diameter to be close to 300. Using a calculator the answer is 299.8 units.
4. Since C is close to 8100, we can estimate the diameter to be close to 2700. Using a calculator the answer is 2570.4 units.
5. Since D is close to 9000, and circumference is about 3 times the diameter, we can estimate the circumference to be close to 27,000. Using a calculator the answer is 29,719.5 units.
6. Since D is close to 6000, we can estimate the circumference to be close to 18,000. Using a calculator the answer is 18,779.2 units.
7. 31.83 cm

***Answers and/or discussion are included in the lesson.**