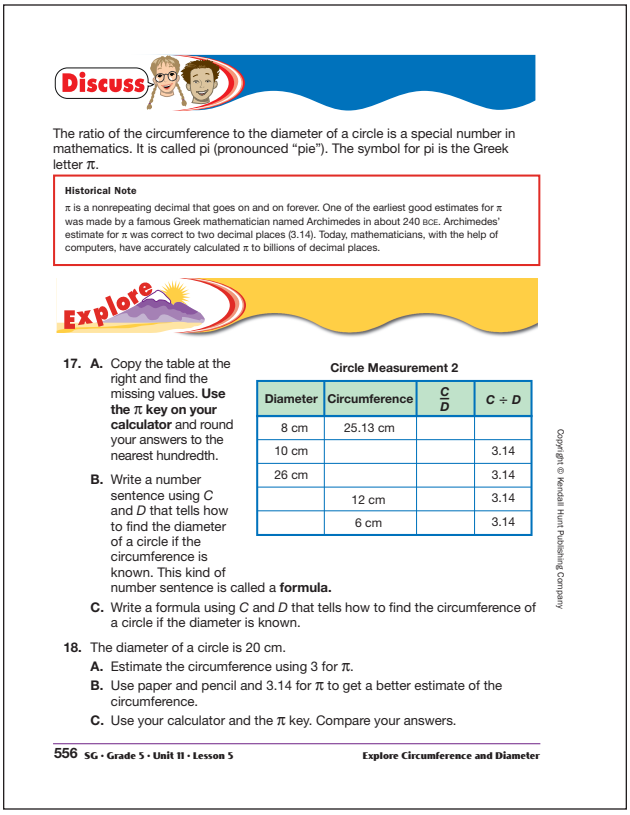

Discuss

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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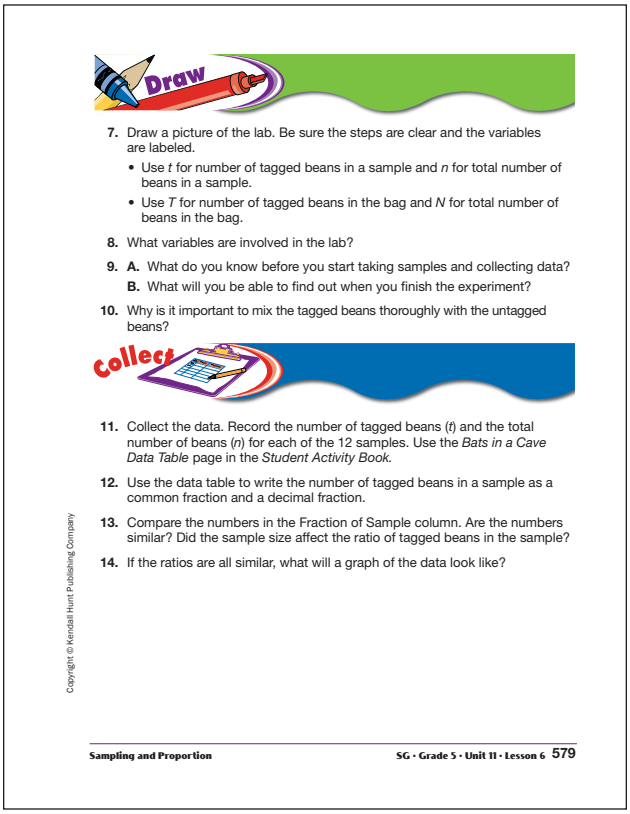

Draw

7. Draw a picture of the lab. Be sure the steps are clear and the variables are labeled.

- Use *t* for number of tagged beans in a sample and *n* for total number of beans in a sample.
- Use *T* for number of tagged beans in the bag and *N* for total number of beans in the bag.

8. What variables are involved in the lab?

9. A. What do you know before you start taking samples and collecting data?

B. What will you be able to find out when you finish the experiment?

10. Why is it important to mix the tagged beans thoroughly with the untagged beans?

Collect

11. Collect the data. Record the number of tagged beans (*t*) and the total number of beans (*n*) for each of the 12 samples. Use the *Bats in a Cave Data Table* page in the *Student Activity Book*.

12. Use the data table to write the number of tagged beans in a sample as a common fraction and a decimal fraction.

13. Compare the numbers in the Fraction of Sample column. Are the numbers similar? Did the sample size affect the ratio of tagged beans in the sample?

14. If the ratios are all similar, what will a graph of the data look like?

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Student Guide

Sampling and Proportion
Questions 1–20 (SG p. 576–581)

1–2. See Figure 1 in the lesson.

3. A.* The points form three distinct clusters or groupings on the graph.

B.* If there are no bats in the sample, there will be no tagged bats. ($n = 0, t = 0$)

C.* See Figure 1 in the lesson.

4. A.* $\frac{t}{n} = \frac{8}{80}$ **B.*** $\frac{t}{n} = \frac{16}{160}$

C. Yes; Since these two ratios can be reduced to $\frac{1}{10}$, so they are equivalent.

5. A.* Ratios will vary; however, all ratios should be approximately equal to $\frac{1}{10}$.

B. Yes

6. A–B.* As the sample size gets larger, the number of tagged bats gets larger. As the sample size gets smaller, the number of tagged bats gets smaller.

7.* See Figure 3 in the lesson for a sample picture.

8.* The number of tagged beans in a sample *(t)*, total number of beans in the sample *(n)*, number of tagged beans in the bag *(T)*, and the total number of beans in the bag *(N)*.

9. A.* We know that the number of tagged beans in the bag *(T)* is 250.

B.* We will find the total number of beans in the bag.

10.* so that the tagged beans will spread evenly and thus the samples of the same size have approximately the same number of tagged bats

11–12.* See Figure 4 in the lesson for a sample table.

13. The ratios are all similar. Using the data in Figure 4, the ratios are all around $\frac{20}{100}$. The size did not effect the ratio of tagged beans (bats) in the sample.

14. The graph should look like a line starting from (0,0).

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

15. A–C.* See Figure 5 in the lesson for a sample graph.

16. A.* Based on the sample graph given, $t = 20$ tagged beans

B.* Based on the sample graph given, $n = 245$ beans

17.* Possible response: $\frac{t}{n} = \frac{20 \text{ tagged beans}}{100 \text{ beans}} = \frac{1 \text{ tagged bean}}{5 \text{ beans}} = 0.20$

18. A.* Points will vary. One possible ratio would be $\frac{t}{n} = \frac{33}{160}$.

B. Yes; $\frac{33 \text{ tagged beans}}{160 \text{ beans}} \approx 0.21$

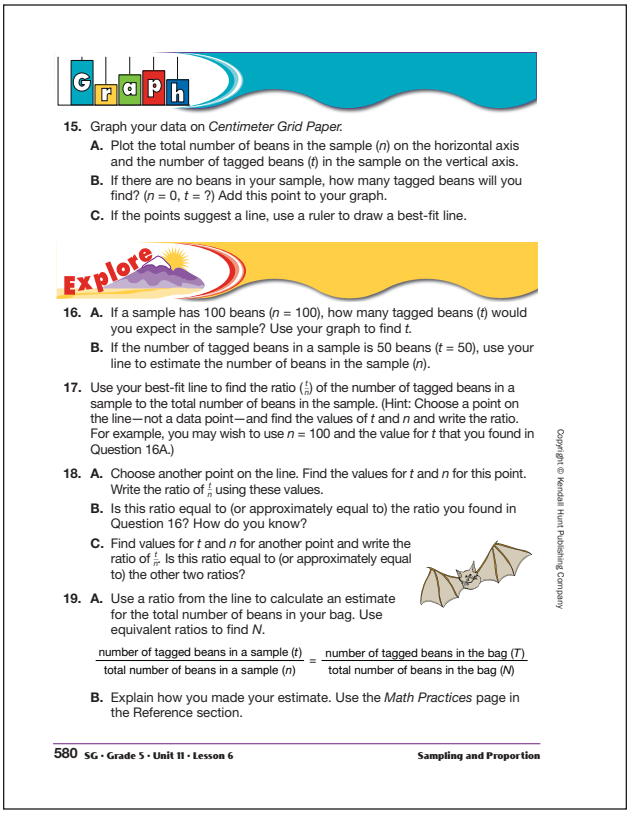
C. $\frac{t}{n} = \frac{42 \text{ tagged beans}}{200 \text{ beans}} \approx 0.21$

19. A.* One possible strategy:

$$\frac{1 \text{ tagged bean}}{5 \text{ beans}} = \frac{250 \text{ tagged beans}}{N}$$

estimate 1250 beans in bag

B.* See the lesson for possible solution paths.



Graph

15. Graph your data on *Centimeter Grid Paper.*
   - **A.** Plot the total number of beans in the sample (n) on the horizontal axis and the number of tagged beans (t) in the sample on the vertical axis.
   - **B.** If there are no beans in your sample, how many tagged beans will you find? ($n = 0$, $t = ?$) Add this point to your graph.
   - **C.** If the points suggest a line, use a ruler to draw a best-fit line.

Explore

16. **A.** If a sample has 100 beans ($n = 100$), how many tagged beans (t) would you expect in the sample? Use your graph to find t.
   - **B.** If the number of tagged beans in a sample is 50 beans ($t = 50$), use your line to estimate the number of beans in the sample (n).

17. Use your best-fit line to find the ratio $(\frac{t}{n})$ of the number of tagged beans in a sample to the total number of beans in the sample. (Hint: Choose a point on the line—not a data point—and find the values of t and n and write the ratio. For example, you may wish to use $n = 100$ and the value for t that you found in Question 16A.)

18. **A.** Choose another point on the line. Find the values for t and n for this point. Write the ratio of $\frac{t}{n}$ using these values.
   - **B.** Is this ratio equal to (or approximately equal to) the ratio you found in Question 16? How do you know?
   - **C.** Find values for t and n for another point and write the ratio of $\frac{t}{n}$. Is this ratio equal to (or approximately equal to) the other two ratios?

19. **A.** Use a ratio from the line to calculate an estimate for the total number of beans in your bag. Use equivalent ratios to find N.

$$\frac{\text{number of tagged beans in a sample } (t)}{\text{total number of beans in a sample } (n)} = \frac{\text{number of tagged beans in the bag } (T)}{\text{total number of beans in the bag } (N)}$$

   - **B.** Explain how you made your estimate. Use the *Math Practices* page in the Reference section.

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

20. Look at the data in your table.
   A. If you had only taken one sample, would the data give you a good estimate for the total number of beans in your bag? Why or why not?
   B. You took four samples for each sample size. Do you recommend the same, more, or fewer samples? Why?

Homework

You will need a piece of *Centimeter Grid Paper* and a ruler to complete the homework.

This is Arti and Lee Yah's data. They captured samples of 100, 200, and 300 bats (pinto beans) from a cave (bag).

Pinto Bat Cave

n Number of Beans (Bats) in Sample	*t* Number of Tagged Beans (Bats) in Sample
100	7
100	8
100	6
100	5
200	15
200	14
200	13
200	10
300	21
300	20
300	18
300	15

1. Graph Arti and Lee Yah's data. Plot the number of beans in the sample (*n*) on the horizontal axis and the number of tagged beans (*t*) on the vertical axis.
2. **A.** If Arti and Lee Yah have no beans in a sample, how many tagged beans will they find? ($n = 0$, $t = ?$) Add this point to your graph.
   B. Draw a best-fit line.
3. Use the line to find the number of tagged beans that would be expected in a sample of 150 beans.
4. Use the line to find the number of tagged beans that would be expected if Arti and Lee Yah take a sample of 400 beans.
5. If there are a total of 200 tagged beans in the bag, calculate an estimate for the total number of beans in the Pinto Bat Cave. Show or tell how you made your estimate.

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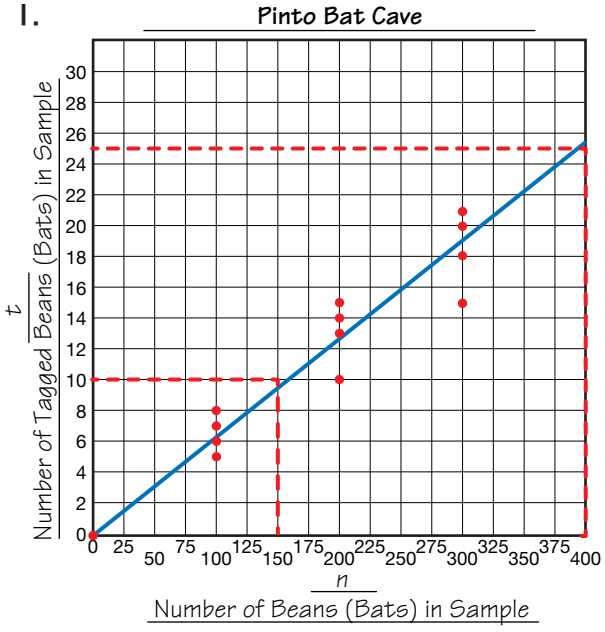
20. **A.*** No; Taking more than one sample reduces the chances of error.
   B. Answers will vary. Possible response: I think four samples was a good amount. Any more data points would probably fall along the best-fit line. Fewer samples might not have been enough.

Homework (SG p. 581) Questions 1–5

Solutions will vary slightly.

1.



2. **A.** $n = 0, t = 0$
   B. See graph in Question 1.
3. $t = 10$; see graph
4. $t = 25$ tagged beans; see graph
5. Possible explanation:

$$\frac{25 \text{ tagged beans}}{400 \text{ beans}} = \frac{200 \text{ tagged beans}}{N}$$

$N \approx 3200$ beans

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