I've completed a circle graph analyzing what you do each day.

I took a survey of pet owners on how many times per day you should treat your dog to a biscuit.

Data Displays

10.1 Stem-and-Leaf Plots

10.2 Histograms

10.3 Shapes of Distributions

10.4 Box-and-Whisker Plots

"I took a survey of pet owners on how many times per day you should treat your dog to a biscuit."

"What do you think?"

"You just couldn't resist participating yourself, could you?"

"For the sake of privacy, can't we label the 2% part as "other"?"

"I've completed a circle graph analyzing what you do each day."
What You Learned Before

Analyzing Bar Graphs

Example 1  The bar graph shows the favorite colors of the students in a class. How many students said their favorite color is blue?

The height of the bar labeled “Blue” is 8.

So, 8 students said their favorite color is blue.

Try It Yourself

1. What color was chosen the least?
2. How many students said green or red is their favorite color?
3. How many students did not choose yellow as their favorite color?
4. How many students are in the class?

Finding Percents

Example 2  The circle graph shows the favorite fruits of the students in a class. There are 20 students in the class. How many students said their favorite fruit is an orange?

Find 25% of 20.

\[
25\% \text{ of } 20 = \frac{1}{4} \times 20 = \frac{1}{4} \times \frac{20}{1} = 5
\]

So, 5 students said their favorite fruit is an orange.

Try It Yourself

5. How many students said their favorite fruit is an apple?
6. How many students said their favorite fruit is a banana?
Essential Question How can you use place values to represent data graphically?

1 ACTIVITY: Making a Data Display

Work with a partner. The list below gives the ages of these women when they became first ladies of the United States.

Ages of First Ladies

<table>
<thead>
<tr>
<th>Ages of First Ladies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

Frances Cleveland - 21  Mamie Eisenhower - 56
Caroline Harrison - 56  Jacqueline Kennedy - 31
Ida McKinley - 49  Claudia Johnson - 50
Edith Roosevelt - 40  Patrizia Nixon - 56
Helen Taft - 48  Elizabeth Ford - 56
Ellen Wilson - 52  Rosalynn Carter - 49
Florence Harding - 60  Nancy Reagan - 59
Grace Coolidge - 49  Barbara Bush - 63
Lou Hoover - 54  Hillary Clinton - 45
Eleanor Roosevelt - 48  Laura Bush - 54
Elizabeth Truman - 60  Michelle Obama - 45

THE WHITE HOUSE
WASHINGTON

THE WHITE HOUSE
WASHINGTON

a. The incomplete data display shows the ages of the first ladies in the left column of the list above.
What do the numbers to the left of the line represent? What do the numbers to the right of the line represent?

b. This data display is called a stem-and-leaf plot.
What numbers do you think represent the stems? leaves? Explain your reasoning.

c. Complete the stem-and-leaf plot using the remaining ages in the right column. Order the numbers to the right of the line in numerical order.

d. REASONING Write a question about the ages of first ladies that would be easier to answer using a stem-and-leaf plot than a dot plot.
**ACTIVITY: Making a Back-to-Back Stem-and-Leaf Plot**

Work with a partner. The table below shows the ages of presidents of the United States from 1885 to 2009 on their first inauguration day.

<table>
<thead>
<tr>
<th>Ages of Presidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 55 54 42 51 56 55 51 54 51 60</td>
</tr>
<tr>
<td>62 43 55 56 61 52 69 64 46 54 47</td>
</tr>
</tbody>
</table>

a. On your stem-and-leaf plot from Activity 1(c), draw a vertical line to the left of the display. Represent the ages of the presidents by including numbers to the left of the line.

b. Find the median ages of both the first ladies and the presidents of the United States.

c. Compare the distribution of each data set.

**ACTIVITY: Conducting an Experiment**

Work with a partner. Use two number cubes to conduct the following experiment.

- Toss the cubes and find the product of the resulting numbers.
- Repeat this process 30 times. Record your results.

a. Use a stem-and-leaf plot to organize your results.

b. Describe the distribution of the data.

**What Is Your Answer?**

4. **IN YOUR OWN WORDS** How can you use place values to represent data graphically?

5. How can you display data in a stem-and-leaf plot whose values range from 82 through 129?

Use what you learned about stem-and-leaf plots to complete Exercises 4 and 5 on page 438.
### Key Idea

**Stem-and-Leaf Plots**

A **stem-and-leaf plot** uses the digits of data values to organize a data set. Each data value is broken into a **stem** (digit or digits on the left) and a **leaf** (digit or digits on the right).

A stem-and-leaf plot shows how data are distributed.

#### Example 1: Making a Stem-and-Leaf Plot

Make a stem-and-leaf plot of the length of the 12 cell phone calls.

**Step 1:** Order the data.

2, 3, 5, 6, 10, 14, 18, 23, 23, 30, 36, 55

**Step 2:** Choose the stems and the leaves. Because the data values range from 2 to 55, use the **tens** digits for the stems and the **ones** digits for the leaves. Be sure to include the key.

**Step 3:** Write the stems to the **left** of the vertical line.

**Step 4:** Write the leaves for each stem to the **right** of the vertical line.

### Exercises 4–9

#### Hair Length (centimeters)

<table>
<thead>
<tr>
<th>Hair Length (centimeters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
</tr>
</tbody>
</table>
EXAMPLE 2  Interpreting a Stem-and-Leaf Plot

The stem-and-leaf plot shows student test scores. (a) How many students scored less than 80 points? (b) How many students scored at least 90 points? (c) How are the data distributed?

a. There are five scores less than 80 points: 66, 70, 75, 77, and 78.

b. There are four scores of at least 90 points: 90, 92, 99, and 100.

Key: 9 | 2 = 92 points

EXAMPLE 3  Making Conclusions from a Stem-and-Leaf Plot

Which statement is not true?

A: Most of the plants are less than 20 inches tall.
B: The median plant height is 11 inches.
C: The range of the plant heights is 35 inches.
D: The plant height that occurs most often is 11 inches.

There are 15 plant heights. So, the median is the eighth data value, 10 inches.

Key: 1 | 5 = 15 inches

The correct answer is (B).

On Your Own

2. Use the grading scale at the right.
   a. How many students received a B on the test?
   b. How many students received a C on the test?

A: 90–100
B: 80–89
C: 70–79
D: 60–69
F: 59 and below

On Your Own

3. You are told that three plants are taller than 20 inches. Is the statement true? Explain.
1. **VOCABULARY**  The key for a stem-and-leaf plot is $3\mid 4 = 34$. Which number is the stem? Which number is the leaf?

2. **WRITING**  Describe how to make a stem-and-leaf plot of the data values 14, 22, 9, 13, 30, 8, 25, and 29.

3. **WRITING**  How does a stem-and-leaf plot show the distribution of data?

Make a stem-and-leaf plot of the data.

4. **Books Read**

<table>
<thead>
<tr>
<th></th>
<th>26</th>
<th>15</th>
<th>20</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31</td>
<td>25</td>
<td>29</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>26</td>
<td>19</td>
<td>40</td>
</tr>
</tbody>
</table>

5. **Hours Online**

<table>
<thead>
<tr>
<th></th>
<th>8</th>
<th>12</th>
<th>21</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
<td>6</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>17</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

6. **Test Scores (%)**

<table>
<thead>
<tr>
<th></th>
<th>87</th>
<th>82</th>
<th>95</th>
<th>91</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>88</td>
<td>68</td>
<td>87</td>
<td>65</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>97</td>
<td>85</td>
<td>80</td>
<td>90</td>
<td>62</td>
</tr>
</tbody>
</table>

7. **Points Scored**

<table>
<thead>
<tr>
<th></th>
<th>58</th>
<th>50</th>
<th>42</th>
<th>71</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45</td>
<td>51</td>
<td>43</td>
<td>38</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>70</td>
<td>56</td>
<td>58</td>
<td>43</td>
</tr>
</tbody>
</table>

8. **Bikes Sold**

<table>
<thead>
<tr>
<th></th>
<th>78</th>
<th>112</th>
<th>105</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>86</td>
<td>96</td>
<td>115</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>79</td>
<td>81</td>
<td>99</td>
<td>108</td>
</tr>
</tbody>
</table>

9. **Minutes in Line**

<table>
<thead>
<tr>
<th></th>
<th>4.0</th>
<th>2.6</th>
<th>1.9</th>
<th>3.1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.6</td>
<td>2.2</td>
<td>2.7</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>1.6</td>
<td>2.0</td>
<td>3.1</td>
<td>2.9</td>
</tr>
</tbody>
</table>

10. **ERROR ANALYSIS**  Describe and correct the error in making a stem-and-leaf plot of the data.

51, 25, 47, 42, 55, 26, 50, 44, 55

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5 6</td>
</tr>
<tr>
<td>4</td>
<td>2 4 7</td>
</tr>
<tr>
<td>5</td>
<td>0 1 5 5</td>
</tr>
</tbody>
</table>

**Key:** $4\mid 2 = 42$

11. **PUPPIES**  The weights (in pounds) of eight puppies at a pet store are 12, 24, 17, 8, 18, 31, 24, and 15. Make a stem-and-leaf plot of the data. Describe the distribution of the data.
VOLLEYBALL  The stem-and-leaf plot shows the number of digs for the top 15 players at a volleyball tournament.

12. How many players had more than 60 digs?

13. Find the mean, median, mode, range, and interquartile range of the data.

14. Describe the distribution of the data.

15. Which data value is the outlier? Describe how the outlier affects the mean.

16. REASONING  Each stem-and-leaf plot below has a mean of 39. Without calculating, determine which stem-and-leaf plot has the lesser mean absolute deviation. Explain your reasoning.

17. TEMPERATURE  The stem-and-leaf plot shows the daily high temperatures (in degrees Fahrenheit) for the first 15 days of a month.

a. Find and interpret the mean absolute deviation of the data.

b. After you include the daily high temperatures for the rest of the month in the stem-and-leaf plot, the mean absolute deviation increases. Where do you think most of the data values for the rest of the month are located in the stem-and-leaf plot? Explain.

18. Critical Thinking  The back-to-back stem-and-leaf plot shows the 9-hole golf scores for two golfers. Only one of the golfers can compete in a tournament. Use measures of center and measures of variation to give reasons why you would choose each golfer.

Fair Game Review  What you learned in previous grades & lessons

Draw the solid.  (Section 8.1)

19. square pyramid  20. hexagonal prism

21. MULTIPLE CHOICE In a bar graph, what determines the length of each bar? (Skills Review Handbook)

   A  frequency  B  data value  C  leaf  D  change in data
Essential Question: How can you use intervals, tables, and graphs to organize data?

1. **ACTIVITY: Conducting an Experiment**

   Work with a partner.
   a. Roll a number cube 20 times. Record your results in a tally chart.
   b. Make a bar graph of the totals.
   c. Go to the board and enter your totals in the class tally chart.
   d. Make a second bar graph showing the class totals. Compare and contrast the two bar graphs.

2. **ACTIVITY: Using Intervals to Organize Data**

   Work with a partner. You are judging a paper airplane contest. A contestant flies a paper airplane 20 times. You record the following distances:
   20.5 ft, 24.5 ft, 18.5 ft, 19.5 ft, 21.0 ft, 14.0 ft, 12.5 ft, 20.5 ft, 17.5 ft, 24.5 ft, 19.5 ft, 17.0 ft, 18.5 ft, 12.0 ft, 21.5 ft, 23.0 ft, 13.5 ft, 19.0 ft, 22.5 ft, 19.0 ft
   a. Complete the tally chart and the bar graph of the distances.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Tally</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0−12.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.0−15.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.0−18.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0−21.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.0−24.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. Make a different tally chart and bar graph of the distances. Use the following intervals:
   10.0−11.9, 12.0−13.9, 14.0−15.9, 16.0−17.9, 18.0−19.9, 20.0−21.9, 22.0−23.9, 24.0−25.9
   c. Which graph do you think represents the distances better? Explain.
The tally chart in Activity 2 is also called a frequency table. A frequency table groups data values into intervals. The frequency is the number of values in an interval.

**3 ACTIVITY: Developing an Experiment**

Work with a partner.

a. Make the airplane shown from a single sheet of $8\frac{1}{2}$-by-11-inch paper. Then design and make your own paper airplane.

b. PRECISION Fly each airplane 20 times. Keep track of the distance flown each time.

c. MODELING Organize the results of the flights using frequency tables and graphs. Which airplane flies farther? Explain your reasoning.

**What Is Your Answer?**

4. **IN YOUR OWN WORDS** How can you use intervals, tables, and graphs to organize data?

5. What intervals could you use in a graph that displays data whose values range from 40 through 59?

Practice Use what you learned about organizing data into intervals to complete Exercises 4 and 5 on page 445.
Lesson

10.2

Key Idea

Histograms

A histogram is a bar graph that shows the frequency of data values in intervals of the same size.

The height of a bar represents the frequency of the values in the interval.

EXAMPLE 1 Making a Histogram

The frequency table shows the numbers of laps that people in a swimming class completed today. Display the data in a histogram.

Step 1: Draw and label the axes.
Step 2: Draw a bar to represent the frequency of each interval.

<table>
<thead>
<tr>
<th>Number of Laps</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–3</td>
<td>11</td>
</tr>
<tr>
<td>4–6</td>
<td>4</td>
</tr>
<tr>
<td>7–9</td>
<td>0</td>
</tr>
<tr>
<td>10–12</td>
<td>3</td>
</tr>
<tr>
<td>13–15</td>
<td>6</td>
</tr>
</tbody>
</table>

On Your Own

1. The frequency table shows the ages of people riding a roller coaster. Display the data in a histogram.

<table>
<thead>
<tr>
<th>Age</th>
<th>10–19</th>
<th>20–29</th>
<th>30–39</th>
<th>40–49</th>
<th>50–59</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>16</td>
<td>11</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
EXAMPLE 2 Using a Histogram

The histogram shows the winning speeds at the Daytona 500. (a) Which interval contains the most data values? (b) How many of the winning speeds are less than 140 miles per hour? (c) How many of the winning speeds are at least 160 miles per hour?

![Daytona 500 Winning Speeds](image)

- **a.** The interval with the tallest bar contains the most data values.
  
  So, the 150–159 miles per hour interval contains the most data values.

- **b.** One winning speed is in the 120–129 miles per hour interval, and four winning speeds are in the 130–139 miles per hour interval.
  
  So, $1 + 4 = 5$ winning speeds are less than 140 miles per hour.

- **c.** Seven winning speeds are in the 160–169 miles per hour interval, and five winning speeds are in the 170–179 miles per hour interval.
  
  So, $7 + 5 = 12$ winning speeds are at least 160 miles per hour.

On Your Own

2. The histogram shows the numbers of hours that students in a class slept last night.

- **a.** How many students slept at least 8 hours?

- **b.** How many students slept less than 12 hours?
EXAMPLE 3  Comparing Data Displays

The data displays show how many push-ups students in a class completed for a physical fitness test. Which data display can you use to find how many students are in the class? Explain.

You can use the histogram because it shows the number of students in each interval. The sum of these values represents the number of students in the class. You cannot use the circle graph because it does not show the number of students in each interval.

EXAMPLE 4  Making Conclusions from Data Displays

Which statement cannot be made using the data displays in Example 3?

A) Twelve percent of the class completed less than 10 push-ups.
B) Five students completed at least 10 and at most 19 push-ups.
C) At least one student completed more than 39 push-ups.
D) Twenty-nine percent of the class completed 30 or more push-ups.

The circle graph shows that 12% completed 0–9 push-ups. So, Statement A can be made.

In the histogram, the bar height for the 10–19 interval is 5, and the bar height for the 40–49 interval is 1. So, Statements B and C can be made.

The circle graph shows that 24% completed 30–39 push-ups, and 4% completed 40–49 push-ups. So, 24% + 4% = 28% completed 30 or more push-ups. Statement D cannot be made.

The correct answer is (D).

On Your Own

3. In Example 3, which data display should you use to describe the portion of the entire class that completed 30–39 push-ups?

4. Make two more conclusions from the data displays in Example 3.
1. **VOCABULARY** Which graph is a histogram? Explain your reasoning.

2. **REASONING** Describe the outliers in the histogram.

3. **REASONING** How can you tell when an interval of a histogram has a frequency of zero?

---

Make a tally chart and a bar graph of the data.

4. **Members of Book Clubs**

<table>
<thead>
<tr>
<th>Members</th>
<th>6</th>
<th>17</th>
<th>13</th>
<th>19</th>
<th>13</th>
<th>9</th>
<th>18</th>
<th>24</th>
<th>11</th>
<th>15</th>
<th>21</th>
<th>14</th>
</tr>
</thead>
</table>

5. **Points Scored**

| Points Scored | 42 | 45 | 57 | 39 | 55 | 38 | 48 | 36 | 48 | 46 | 51 | 29 | 45 | 54 | 42 |

Display the data in a histogram.

6. **States Visited**

<table>
<thead>
<tr>
<th>States</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–5</td>
<td>12</td>
</tr>
<tr>
<td>6–10</td>
<td>14</td>
</tr>
<tr>
<td>11–15</td>
<td>6</td>
</tr>
<tr>
<td>16–20</td>
<td>3</td>
</tr>
</tbody>
</table>

7. **Chess Team**

<table>
<thead>
<tr>
<th>Wins</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–13</td>
<td>3</td>
</tr>
<tr>
<td>14–17</td>
<td>4</td>
</tr>
<tr>
<td>18–21</td>
<td>4</td>
</tr>
<tr>
<td>22–25</td>
<td>2</td>
</tr>
</tbody>
</table>

8. **Movies Watched**

<table>
<thead>
<tr>
<th>Movies</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1</td>
<td>5</td>
</tr>
<tr>
<td>2–3</td>
<td>11</td>
</tr>
<tr>
<td>4–5</td>
<td>8</td>
</tr>
<tr>
<td>6–7</td>
<td>1</td>
</tr>
</tbody>
</table>

9. **ERROR ANALYSIS** Describe and correct the error made in displaying the data in a histogram.

<table>
<thead>
<tr>
<th>Confirmed Flu Cases per School</th>
<th>Cases</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>0–2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3–5</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>6–8</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>9–11</td>
<td>12</td>
</tr>
</tbody>
</table>
10. **MAGAZINES** The histogram shows the number of magazines read last month by the students in a class.

   a. Which interval contains the fewest data values?
   b. How many students are in the class?
   c. What percent of the students read less than six magazines?
   d. Can you find the mean or the median of the data? Explain.

11. **ERROR ANALYSIS** Describe and correct the error made in reading the histogram.

   12% of the songs took 5–8 seconds to download.

12. **VOTING** The histogram shows the percent of the voting-age population that voted in a recent presidential election. Explain whether the graph supports each statement.

   a. Only 40% of one state voted.
   b. In most states, between 50% and 64.9% voted.
   c. The mode of the data is between 55 and 59.9.

13. **PROBLEM SOLVING** The histograms show the areas of counties in Pennsylvania and Indiana. Which state do you think has the greater area? Explain.
14. **GARBAGE** The data displays show how many pounds of garbage apartment residents produced in 1 week. Which data display can you use to find how many residents produced more than 25 pounds of garbage? Explain.

15. **REASONING** Determine whether you can make each statement by using the data displays in Exercise 14. Explain your reasoning.
   a. One resident produced 10 pounds of garbage.
   b. Twelve residents produced between 20 and 29 pounds of garbage.

16. **NUMBER SENSE** Can you find the range and the interquartile range of the data in Exercise 7? If so, find them. If you cannot find them, explain why not.

17. **CRITICAL THINKING** The table shows the weights of guide dogs enrolled in a training program.
   a. Make a histogram of the data starting with the interval 51–55.
   b. Make another histogram of the data using different-sized intervals.
   c. Compare and contrast the two histograms.

18. **Logic** What are the possible values for the median in Exercise 10?

---

**Fair Game Review**

What you learned in previous grades & lessons

Find the percent of the number.  *(Section 5.6)*

19. 25% of 180  
20. 30% of 90  
21. 16% of 140  
22. 64% of 80

23. **MULTIPLE CHOICE** Which is the solution of the inequality represented by “Four times a number n is at least 28”? *(Section 7.7)*

   A. $n < 7$  
   B. $n > 7$  
   C. $n \leq 7$  
   D. $n \geq 7$
You can use a **word magnet** to organize information associated with a vocabulary word. Here is an example of a word magnet for histogram.

### On Your Own

Make a word magnet to help you study this topic.

1. stem-and-leaf plot

After you complete this chapter, make word magnets for the following topics.

2. shapes of distributions
3. box-and-whisker plot
4. Choose three other topics that you studied earlier in this course. Make a word magnet for each topic.
10.1–10.2 Quiz

Make a stem-and-leaf plot of the data. (Section 10.1)

1. **Cans Collected Each Month**
   
<table>
<thead>
<tr>
<th>Cans Collected Each Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
</tr>
<tr>
<td>76</td>
</tr>
<tr>
<td>68</td>
</tr>
</tbody>
</table>

2. **Miles Driven Each Day**
   
<table>
<thead>
<tr>
<th>Miles Driven Each Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>35</td>
</tr>
</tbody>
</table>

3. **Ages of Tortoises**
   
<table>
<thead>
<tr>
<th>Ages of Tortoises</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
</tr>
<tr>
<td>92</td>
</tr>
<tr>
<td>115</td>
</tr>
</tbody>
</table>

4. **Kilometers Run Each Day**
   
<table>
<thead>
<tr>
<th>Kilometers Run Each Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
</tr>
<tr>
<td>3.5</td>
</tr>
<tr>
<td>6.2</td>
</tr>
</tbody>
</table>

Display the data in a histogram. (Section 10.2)

5. **Soccer Team Goals**
   
<table>
<thead>
<tr>
<th>Soccer Team Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals per Game</td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>0–1</td>
</tr>
<tr>
<td>2–3</td>
</tr>
<tr>
<td>4–5</td>
</tr>
<tr>
<td>6–7</td>
</tr>
</tbody>
</table>

6. **Minutes Practiced**
   
<table>
<thead>
<tr>
<th>Minutes Practiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes</td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>0–19</td>
</tr>
<tr>
<td>20–39</td>
</tr>
<tr>
<td>40–59</td>
</tr>
<tr>
<td>60–79</td>
</tr>
</tbody>
</table>

7. **Poems Written for Class**
   
<table>
<thead>
<tr>
<th>Poems Written for Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poems</td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>0–4</td>
</tr>
<tr>
<td>5–9</td>
</tr>
<tr>
<td>10–14</td>
</tr>
<tr>
<td>15–19</td>
</tr>
<tr>
<td>20–24</td>
</tr>
</tbody>
</table>

8. **WEIGHTS** The weights (in ounces) of nine packages are 7, 22, 16, 12, 6, 18, 15, 13, and 25. Make a stem-and-leaf plot of the data. Describe the distribution of the data. (Section 10.1)

9. **REBOUNDS** The histogram shows the number of rebounds per game for a middle school basketball player this season. (Section 10.2)
   
   a. Which interval contains the most data values?
   
   b. How many games did the player play this season?
   
   c. What percent of the games did the player have 4 or more rebounds?

10. **STAGE CREW** The stem-and-leaf plot shows the number of hours 11 stage crew members spent building sets. Find the mean, median, mode, range, and interquartile range of the data. (Section 10.1)

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6 8 8 9</td>
</tr>
<tr>
<td>1</td>
<td>0 1 2 3 7 8</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

   Key: 0|9 = 9 hours
10.3 Shapes of Distributions

Essential Question How can you describe the shape of the distribution of a data set?

ACTIVITY: Describing the Shape of a Distribution

Work with a partner. The lists at the left show the last four digits of a set of phone numbers in a phone book.

a. Create a list that represents the last digit of each phone number shown. Make a dot plot of the data.

b. In your own words, how would you describe the shape of the distribution? What single word do you think you can use to identify this type of distribution? Explain your reasoning.

ACTIVITY: Describing the Shape of a Distribution

Work with a partner. The lists at the right show the first three digits of a set of phone numbers in a phone book.

a. Create a list that represents the first digit of each phone number shown. Make a dot plot of the data.

b. In your own words, how would you describe the shape of the distribution? What single word do you think you can use to identify this type of distribution? Explain your reasoning.

c. In your dot plot, draw a vertical line through the middle of the data set. What do you notice?

d. Repeat part (c) for the dot plot you constructed in Activity 1. What do you notice? Compare the distributions from Activities 1 and 2.
The Meaning of a Word • Skewed
When something is skewed, it has a slanted direction or position.

3 ACTIVITY: Describing the Shape of a Distribution
Work with a partner. The table shows the ages of cellular phones owned by a group of students.

<table>
<thead>
<tr>
<th>Ages of Cellular Phones (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

a. Make a dot plot of the data.
b. In your own words, how would you describe the shape of the distribution? Compare it to the distributions in Activities 1 and 2.
c. Why do you think this type of distribution is called a skewed distribution?

4 ACTIVITY: Finding Measures of Center
Work with a partner.

a. Find the means and the medians of the data sets in Activities 1–3.
b. What do you notice about the means and the medians of the data sets and the shapes of the distributions? Explain.
d. Using your answers to part (c), decide which measure of variation you think best describes the data set in Activity 2. Which measure of variation do you think best describes the data set in Activity 3? Explain your reasoning.

What Is Your Answer?
5. IN YOUR OWN WORDS How can you describe the shape of the distribution of a data set?
6. Name two other ways you can describe the distribution of a data set.

Practice
Use what you learned about shapes of distributions to complete Exercises 3 and 4 on page 454.
You can use dot plots and histograms to identify shapes of distributions.

**Key Ideas**

**Symmetric and Skewed Distributions**

- **Skewed left**
  - The “tail” of the graph extends to the left.
  - Most data are on the left.

- **Symmetric**
  - The left side of the graph is a mirror image of the right side of the graph.

- **Skewed right**
  - The “tail” of the graph extends to the right.
  - Most data are on the right.

**Study Tip**

If all the dots of a dot plot or bars of a histogram are about the same height, then the distribution is a flat, or uniform, distribution. A uniform distribution is also symmetric.

---

**Example 1**

**Describing the Shapes of Distributions**

Describe the shape of each distribution.

a. **Daily Snowfall Amounts**

Most of the data are on the left, and the tail extends to the right.

- So, the distribution is skewed right.

b. **Passes Thrown**

The left side of the graph is approximately a mirror image of the right side of the graph.

- So, the distribution is symmetric.

---

**On Your Own**

1. Describe the shape of the distribution.

---

**Exercise 5–8**

- You can use dot plots and histograms to identify shapes of distributions.

**Symmetric and Skewed Distributions**

- **Skewed left**
  - The “tail” of the graph extends to the left.
  - Most data are on the left.

- **Symmetric**
  - The left side of the graph is a mirror image of the right side of the graph.

- **Skewed right**
  - The “tail” of the graph extends to the right.
  - Most data are on the right.

**Study Tip**

If all the dots of a dot plot or bars of a histogram are about the same height, then the distribution is a flat, or uniform, distribution. A uniform distribution is also symmetric.
EXAMPLE 2 Describing the Shape of a Distribution

The frequency table shows the ages of people watching a comedy in a theater. Display the data in a histogram. Describe the shape of the distribution.

<table>
<thead>
<tr>
<th>Ages</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–13</td>
<td>1</td>
</tr>
<tr>
<td>14–17</td>
<td>3</td>
</tr>
<tr>
<td>18–21</td>
<td>7</td>
</tr>
<tr>
<td>22–25</td>
<td>12</td>
</tr>
<tr>
<td>26–29</td>
<td>20</td>
</tr>
<tr>
<td>30–33</td>
<td>18</td>
</tr>
<tr>
<td>34–37</td>
<td>3</td>
</tr>
</tbody>
</table>

Draw and label the axes. Then draw a bar to represent the frequency of each interval.

Most of the data are on the right, and the tail extends to the left.

So, the distribution is skewed left.

EXAMPLE 3 Comparing Shapes of Distributions

The histogram shows the ages of people watching an animated movie in the same theater as in Example 2.

a. Describe the shape of the distribution.

Most of the data are on the left, and the tail extends to the right.

So, the distribution is skewed right.

b. Which movie has an older audience?

The intervals in the histograms are the same. Most of the data for the animated movie are on the left, while most of the data for the comedy are on the right. This means that the people watching the comedy are generally older than the people watching the animated movie.

So, the comedy has an older audience.

2. The frequency table shows the ages of people watching a historical movie in a theater.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>3</td>
<td>18</td>
<td>36</td>
<td>40</td>
<td>14</td>
<td>5</td>
</tr>
</tbody>
</table>

a. Display the data in a histogram. Describe the shape of the distribution.

b. Compare the distribution of the data to the distributions in Examples 2 and 3. What can you conclude?
10.3 Exercises

Vocabulary and Concept Check

1. **VOCABULARY** How does the shape of a symmetric distribution differ from the shape of a skewed distribution?

2. **VOCABULARY** For a distribution that is skewed right, which direction does the tail extend? Where do most of the data lie?

Practice and Problem Solving

Make a dot plot of the data. In your own words, how would you describe the shape of the distribution?

3. **Miles Run per Day**

<table>
<thead>
<tr>
<th>Miles Run per Day</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

4. **Raffle Tickets Sold**

<table>
<thead>
<tr>
<th>Raffle Tickets Sold</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

Describe the shape of each distribution.

5. **Class Sizes**

6. **Heights of Plants**

7. **Travel Time to School**

8. **Ages of People at a Concert**

9. **POLICE** The frequency table shows the years of service for the police officers of Jones County and Pine County. Display the data for each county in a histogram. Describe the shape of each distribution. Which county's police force has less experience? Explain.

<table>
<thead>
<tr>
<th>Years of Service</th>
<th>0–3</th>
<th>4–7</th>
<th>8–11</th>
<th>12–15</th>
<th>16–19</th>
<th>20–23</th>
<th>24–27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency for Jones County</td>
<td>7</td>
<td>15</td>
<td>17</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Frequency for Pine County</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>14</td>
<td>10</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

454 Chapter 10 Data Displays
10. **REASONING** What is the shape of the distribution of the restaurant waiting times? Explain your reasoning.

11. **LOGIC** Are all distributions either approximately symmetric or skewed? Explain. If not, give an example.

12. **REASONING** Can you use a stem-and-leaf plot to describe the shape of a distribution? Explain your reasoning.

13. **CHARITY** The table shows the donation amounts received by a charity in one day.

<table>
<thead>
<tr>
<th>Donations (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 15 40 70 20 5 25 50 47 20 62 55 40</td>
</tr>
<tr>
<td>10 50 18 20 100 40 80 60 20 80 3 30 50</td>
</tr>
<tr>
<td>25 30 10 33 20 50 7 35 40 25 70</td>
</tr>
</tbody>
</table>

a. Make a histogram of the data starting with the interval 0–14. Describe the shape of the distribution.

b. A company adds $5 to each donation. Make another histogram starting with the same first interval as in part (a). Compare the shape of this distribution with the distribution in part (a). Explain any differences in the distributions.

14. **Critical Thinking** Describe the shape of the distribution of each bar graph. Match the letters A, B, and C with the mean, the median, and the mode of the data set. Explain your reasoning.

a.  

b.  

---

**Fair Game Review** What you learned in previous grades & lessons

Find the median, first quartile, third quartile, and interquartile range of the data.  
* (Section 9.4)

15. 68, 74, 67, 72, 63, 70, 78, 64, 76  
16. 39, 48, 33, 24, 30, 44, 36, 41, 28, 53

17. **MULTIPLE CHOICE** Sixty people participate in a trivia contest. How many four-person teams can be formed?  
* (Section 7.3)

A 15  
B 56  
C 64  
D 240
You can use a measure of center and a measure of variation to describe the distribution of a data set. The shape of the distribution can help you choose which measures are the most appropriate to use.

**Key Idea**

**Choosing Appropriate Measures**

The mean absolute deviation (MAD) uses the mean in its calculation. So, when a data distribution is *symmetric,*
- use the mean to describe the center and
- use the MAD to describe the variation.

The interquartile range (IQR) uses quartiles in its calculation. So, when a data distribution is *skewed,*
- use the median to describe the center and
- use the IQR to describe the variation.

**EXAMPLE 1 Choosing Appropriate Measures**

The dot plot shows the average number of hours students in a class sleep each night.

![Dot plot showing average number of hours students sleep](image)

**a.** What are the most appropriate measures to describe the center and the variation?

Most of the data values are on the right clustered around 9, and the tail extends to the left. The distribution is skewed left.

✦ So, the median and the interquartile range are the most appropriate measures to describe the center and the variation.

**b.** Describe the center and the variation of the data set.

The median is 8.5 hours. The first quartile is 7.5, and the third quartile is 9. So, the interquartile range is $9 - 7.5 = 1.5$ hours.

✦ The data are centered around 8.5 hours. The middle half of the data varies by no more than 1.5 hours.
EXAMPLE 2 Choosing Appropriate Measures

The frequency table shows the number of states that border each state in the United States.

a. Display the data in a histogram.
   Draw and label the axes. Then draw a bar to represent the frequency of each interval.

b. What are the most appropriate measures to describe the center and the variation?
   The left side of the graph is approximately a mirror image of the right side of the graph. The distribution is symmetric.

   So, the mean and the mean absolute deviation are the most appropriate measures to describe the center and the variation.

Practice

Choose the most appropriate measures to describe the center and the variation.
Find the measures you chose.

1. Prices of Jeans

   Prices of Jeans

2. Weekly Biking Times

   Weekly Biking Times

3. REASONING Can you find the exact values of the mean and the mean absolute deviation for the data in Example 2? Explain.

4. GAS MILEAGE The frequency table shows the gas mileages of several vehicles made by a company.

   a. What are the most appropriate measures to describe the center and the variation?

   b. What conclusions can you make?

5. OPEN-ENDED Construct a dot plot for which the mean is the most appropriate measure to describe the center of the distribution.

Mileage (miles per gallon) | Frequency
--- | ---
10–14 | 2
15–19 | 1
20–24 | 6
25–29 | 8
30–34 | 10
35–39 | 3
10.4 Box-and-Whisker Plots

**Essential Question** How can you use quartiles to represent data graphically?

1. **ACTIVITY: Drawing a Box-and-Whisker Plot**

   Work with a partner.

   The numbers of pairs of footwear owned by each student in a sixth grade class are shown.

<table>
<thead>
<tr>
<th>Numbers of Pairs of Footwear</th>
</tr>
</thead>
<tbody>
<tr>
<td>2  5  12  3</td>
</tr>
<tr>
<td>7  2  4  6</td>
</tr>
<tr>
<td>14 10 6  25</td>
</tr>
<tr>
<td>5  3  2  4</td>
</tr>
<tr>
<td>9  25 4  10</td>
</tr>
<tr>
<td>8  15 5  8</td>
</tr>
</tbody>
</table>

   a. Order the data set from least to greatest. Then write the data on a strip of grid paper with 24 boxes.

   b. Use the strip of grid paper to find the median, the first quartile, and the third quartile. Identify the least value and the greatest value in the data set.

   c. Graph the five numbers that you found in part (b) on the number line below.

   ![Number Line](image)

   d. The data display shown below is called a box-and-whisker plot. Fill in the missing labels and numbers. Explain how a box-and-whisker plot uses quartiles to represent the data.

   ![Box-and-Whisker Plot](image)

   e. Using only the box-and-whisker plot, which measure(s) of center can you find for the data set? Which measure(s) of variation can you find for the data set? Explain your reasoning.

   f. Why do you think this type of data display is called a box-and-whisker plot? Explain.
Have your class conduct a survey. Each student will write on the chalkboard the number of pairs of footwear that he or she owns.

Now, work with a partner to draw a box-and-whisker plot of the data.

Work with a partner. The box-and-whisker plots show the test score distributions of two sixth grade achievement tests. The same group of students took both tests. The students took one test in the fall and the other in the spring.

a. Compare and contrast the test results.

b. Decide which box-and-whisker plot represents the results of which test. How did you make your decision?

4. **IN YOUR OWN WORDS** How can you use quartiles to represent data graphically?

5. Describe who might be interested in test score distributions like those shown in Activity 3. Explain why it is important for such people to know test score distributions.

Use what you learned about box-and-whisker plots to complete Exercise 4 on page 463.
Lesson 10.4

**Key Vocabulary**
- box-and-whisker plot, p. 460
- five-number summary, p. 460

**Key Idea**

**Box-and-Whisker Plot**

A box-and-whisker plot represents a data set along a number line by using the least value, the greatest value, and the quartiles of the data. A box-and-whisker plot shows the variability of a data set.

The five numbers that make up the box-and-whisker plot are called the five-number summary of the data set.

**Example 1**

Making a Box-and-Whisker Plot

Make a box-and-whisker plot for the ages (in years) of the spider monkeys at a zoo:

15, 20, 14, 38, 30, 36, 30, 30, 27, 26, 33, 35

**Step 1:** Order the data. Find the median and the quartiles.

**Step 2:** Draw a number line that includes the least and greatest values. Graph points above the number line that represent the five-number summary.

**Step 3:** Draw a box using the quartiles. Draw a line through the median. Draw whiskers from the box to the least and the greatest values.

---

1. A group of friends spent 1, 0, 2, 3, 4, 3, 6, 1, 0, 1, 2, and 2 hours online last night. Make a box-and-whisker plot for the data.
EXAMPLE 2 Analyzing a Box-and-Whisker Plot

The box-and-whisker plot shows the body mass index (BMI) of a sixth grade class.

a. What fraction of the students have a BMI of at least 22?

The right whisker represents students who have a BMI of at least 22.

 nowrap>So, about \( \frac{1}{4} \) of the students have a BMI of at least 22.

b. Are the data more spread out below the first quartile or above the third quartile? Explain.

The right whisker is longer than the left whisker.

 nowrap>So, the data are more spread out above the third quartile than below the first quartile.

c. Find and interpret the interquartile range of the data.

\[
\text{interquartile range} = \text{third quartile} - \text{first quartile} = 22 - 19 = 3
\]

 nowrap>So, the middle half of the students’ BMIs varies by no more than 3.

2. The box-and-whisker plot shows the heights of the roller coasters at an amusement park. (a) What fraction of the roller coasters are between 120 feet tall and 220 feet tall? (b) Are the data more spread out below or above the median? Explain. (c) Find and interpret the interquartile range of the data.

Now You’re Ready Exercises 11 and 12

Section 10.4 Box-and-Whisker Plots
A box-and-whisker plot also shows the shape of a distribution.

**Key Ideas**

**Shapes of Box-and-Whisker Plots**

- **Skewed left**
  - Left whisker longer than right whisker
  - Most data on the right

- **Symmetric**
  - Whiskers about same length
  - Median in the middle of the box

- **Skewed right**
  - Right whisker longer than left whisker
  - Most data on the left

**Example 3**

Comparing Box-and-Whisker Plots

The double box-and-whisker plot represents the prices of snowboards at two stores.

<table>
<thead>
<tr>
<th>Store</th>
<th>Prices (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store A</td>
<td>100-500</td>
</tr>
<tr>
<td>Store B</td>
<td>100-550</td>
</tr>
</tbody>
</table>

**a. Identify the shape of each distribution.**

For Store A, the whisker lengths are equal. The median is in the middle of the box. The data on the left are the mirror image of the data on the right. So, the distribution is symmetric.

For Store B, the right whisker is longer than the left whisker, and most of the data are on the left side of the display. So, the distribution is skewed right.

**b. Which store’s prices are more spread out? Explain.**

Both boxes appear to be the same length. So, the interquartile range of each data set is equal. However, the range of the prices in Store B is greater than the range of the prices in Store A. So, the prices in Store B are more spread out.

**On Your Own**

3. The double box-and-whisker plot represents the life spans of crocodiles and alligators at a zoo. Identify the shape of each distribution. Which reptile’s life spans are more spread out? Explain.
4. The box-and-whisker plots represent the daily attendance at two beaches during July. Compare and contrast the attendances for the two beaches.

Make a box-and-whisker plot for the data.

5. Ages of teachers (in years): 30, 62, 26, 35, 45, 22, 49, 32, 28, 50, 42, 35
6. Quiz scores: 8, 12, 9, 10, 12, 8, 5, 9, 7, 10, 8, 9, 11
8. Ski lengths (in centimeters): 180, 175, 205, 160, 210, 175, 190, 205, 190, 160, 165, 195

9. ERROR ANALYSIS Describe and correct the error in making a box-and-whisker plot for the data.

10. CAMPING The numbers of days 12 friends went camping during the summer are 6, 2, 0, 10, 3, 6, 6, 4, 12, 0, 6, and 2. Make a box-and-whisker plot for the data. What is the range of the data?
11. **DUN TANK** The box-and-whisker plot represents the numbers of gallons of water needed to fill different types of dunk tanks offered by a company.

![Box-and-whisker plot](image)

a. What fraction of the dunk tanks require at least 500 gallons of water?

b. Are the data more spread out below the first quartile or above the third quartile? Explain.

c. Find and interpret the interquartile range of the data.

12. **BUILDINGS** The box-and-whisker plot represents the heights (in meters) of the tallest buildings in Chicago.

![Box-and-whisker plot](image)

a. What percent of the buildings are no taller than 345 meters?

b. Is there more variability in the heights above 345 meters or below 261 meters? Explain.

c. Find and interpret the interquartile range of the data.

**Identify the shape of the distribution. Explain.**

13. **14.**

15. **16.**

17. **RECESS** The double box-and-whisker plot represents the start times of recess for two schools.

![Box-and-whisker plot](image)

a. Identify the shape of each distribution.

b. Which school’s start times for recess are more spread out? Explain.

c. Which school is more likely to have recess before lunch? Explain.
Make a box-and-whisker plot for the data.

18. Temperatures (in °C): 5, 1, 4, 0, 9, 0, −8, 5, 2, 4, −1, 10, 7, −5

19. Checking account balances (in dollars): 30, 0, 50, 20, 90, −15, 40, 100, 45, −20, 70, 0

20. **REASONING** The data set in Exercise 18 has an outlier. Describe how removing the outlier affects the box-and-whisker plot.

21. **CHOOSE TOOLS** What are the most appropriate measures to describe the center and the variation of the distribution in Exercise 12?

22. **OPEN-ENDED** Write a data set with 12 values that has a symmetric box-and-whisker plot.

23. **CRITICAL THINKING** When would a box-and-whisker plot **not** have one or both whiskers?

24. **STRUCTURE** Draw a histogram that could represent the distribution shown in Exercise 15.

25. **REASONING** The double box-and-whisker plot represents the runs scored per game by two softball teams during a 32-game season.

```
<table>
<thead>
<tr>
<th>Team 1</th>
<th>Team 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 4 8 12 16</td>
<td>2 6 10 14</td>
</tr>
</tbody>
</table>
```

a. Which team is more consistent at scoring runs? Explain.

b. In how many games did Team 2 score 6 runs or less?

c. Team 1 played Team 2 once during the season. Which team do you think won? Explain.

d. Which team do you think has the greater mean? Explain.

26. **Choose Tools** A market research company wants to summarize the variability of the SAT scores of graduating seniors in the United States. Do you think the company should use a stem-and-leaf plot, a histogram, or a box-and-whisker plot? Explain.

---

**Fair Game Review** What you learned in previous grades & lessons

(Section 6.3)

27. \( -\frac{2}{3} \) \( < \) \( \frac{3}{4} \)

28. \( -2\frac{1}{5} \) \( < \) \( -2\frac{1}{6} \)

29. \(-5.3\) \( < \) \(-5.5\)

(Section 8.4)

30. **MULTIPLE CHOICE** Which of the following items is most likely represented by a rectangular prism with a volume of 1785 cubic inches?

- [A] closet
- [B] computer tower
- [C] filing cabinet
- [D] your math book

---

**Section 10.4** Box-and-Whisker Plots 465
Describe the shape of each distribution.  

1. Hours Worked

![Hours Worked](image)

2. Museum Attendance

![Museum Attendance](image)

Choose the most appropriate measures to describe the center and the variation. Find the measures you chose. 

3. Prices of Shoes

![Prices of Shoes](image)

4. Commute Times

![Commut Times](image)

Make a box-and-whisker plot for the data. 

5. Science test scores: 85, 76, 99, 84, 92, 95, 68, 100, 93, 88, 87, 85

6. Shoe sizes: 12, 8.5, 9, 10, 9, 11, 11.5, 9, 9, 10, 10, 10.5, 8

7. MOVIES The box-and-whisker plot represents the lengths (in minutes) of movies being shown at a theater. 

![MOVIES](image)

a. What percent of the movies are no longer than 120 minutes?

b. Is there more variability in the movie lengths longer than 130 minutes or shorter than 110 minutes? Explain.

c. Find and interpret the interquartile range of the data.

8. EXPERIENCE The frequency table shows the years of experience of employees at two branches of a company. Display the data for each branch in a histogram. Describe the shape of each distribution. Which branch has less experience? Explain. 

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>0–2</th>
<th>3–6</th>
<th>7–10</th>
<th>11–14</th>
<th>15–18</th>
<th>19–22</th>
<th>23–26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency at Branch A</td>
<td>10</td>
<td>25</td>
<td>14</td>
<td>20</td>
<td>8</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Frequency at Branch B</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>15</td>
<td>25</td>
<td>8</td>
</tr>
</tbody>
</table>

466 Chapter 10 Data Displays
Review Key Vocabulary

- Stem-and-leaf plot, p. 436
- Frequency table, p. 441
- Box-and-whisker plot, p. 460
- Stem, p. 436
- Frequency, p. 441
- Histogram, p. 442
- Leaf, p. 436
- Five-number summary, p. 460

Review Examples and Exercises

10.1 Stem-and-Leaf Plots (pp. 434–439)

Make a stem-and-leaf plot of the number of DVDs rented each day at a store.

Step 1: Order the data. 19, 25, 28, 39, 50, 50, 53

Step 2: Choose the stems and the leaves. Because the data range from 19 to 53, use the tens digits for the stems and the ones digits for the leaves. Be sure to include the key.

Step 3: Write the stems to the left of the vertical line.

Step 4: Write the leaves for each stem to the right of the vertical line.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>5 8</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0 0 3</td>
</tr>
</tbody>
</table>

Key: 2 | 5 = 25 DVDs

Exercises

Make a stem-and-leaf plot of the data.

1. Hats Sold Each Day

<table>
<thead>
<tr>
<th>Hats Sold Each Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 18 12 15</td>
</tr>
<tr>
<td>21 30 8 12</td>
</tr>
<tr>
<td>13 9 14 25</td>
</tr>
</tbody>
</table>

2. Ages of Park Volunteers

<table>
<thead>
<tr>
<th>Ages of Park Volunteers</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 17 40 15</td>
</tr>
<tr>
<td>48 21 19 52</td>
</tr>
<tr>
<td>13 55 60 20</td>
</tr>
</tbody>
</table>

The stem-and-leaf plot shows the weights (in pounds) of yellowfin tuna caught during a fishing contest.

3. How many tuna weigh less than 90 pounds?

4. What is the median weight of the tuna?

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>0 2 5 7 9</td>
</tr>
<tr>
<td>9</td>
<td>5 6</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

Key: 8 | 5 = 85 pounds
## 10.2 Histograms (pp. 440–447)

The frequency table shows the number of crafts each member of a craft club made for a fundraiser. Display the data in a histogram.

<table>
<thead>
<tr>
<th>Crafts</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–2</td>
<td>10</td>
</tr>
<tr>
<td>3–5</td>
<td>8</td>
</tr>
<tr>
<td>6–8</td>
<td>5</td>
</tr>
<tr>
<td>9–11</td>
<td>0</td>
</tr>
<tr>
<td>12–14</td>
<td>2</td>
</tr>
</tbody>
</table>

**Step 1:** Draw and label the axes.

**Step 2:** Draw a bar to represent the frequency of each interval.

### Exercises

Display the data in a histogram.

5. **Heights of Gymnasts**

<table>
<thead>
<tr>
<th>Heights (in.)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>50–54</td>
<td>1</td>
</tr>
<tr>
<td>55–59</td>
<td>8</td>
</tr>
<tr>
<td>60–64</td>
<td>5</td>
</tr>
<tr>
<td>65–69</td>
<td>2</td>
</tr>
</tbody>
</table>

6. **Minutes Studied**

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–19</td>
<td>5</td>
</tr>
<tr>
<td>20–39</td>
<td>9</td>
</tr>
<tr>
<td>40–59</td>
<td>12</td>
</tr>
<tr>
<td>60–79</td>
<td>3</td>
</tr>
</tbody>
</table>

### 10.3 Shapes of Distributions (pp. 450–457)

Describe the shape of each distribution.

a. **Pets Owned**

Most of the data are on the left, and the tail extends to the right.

.Symbol: So, the distribution is skewed right.

b. **Biology Test Scores**

Most of the data are on the right, and the tail extends to the left.

.Symbol: So, the distribution is skewed left.
7. Describe the shape of the distribution.

8. Choose the most appropriate measures to describe the center and the variation. Find the measures you chose.

**Daily High Temperatures**

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>30–39</td>
<td>2</td>
</tr>
<tr>
<td>40–49</td>
<td>5</td>
</tr>
<tr>
<td>50–59</td>
<td>7</td>
</tr>
<tr>
<td>60–69</td>
<td>8</td>
</tr>
<tr>
<td>70–79</td>
<td>6</td>
</tr>
<tr>
<td>80–89</td>
<td>5</td>
</tr>
<tr>
<td>90–99</td>
<td>2</td>
</tr>
</tbody>
</table>

**Students’ Heights**

<table>
<thead>
<tr>
<th>Height (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
</tr>
<tr>
<td>59</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>61</td>
</tr>
<tr>
<td>62</td>
</tr>
</tbody>
</table>

**10.4 Box-and-Whisker Plots** (pp. 458–465)

Make a box-and-whisker plot for the weights (in pounds) of pumpkins sold at a market.

16, 20, 14, 15, 12, 8, 8, 19, 14, 10, 8, 16

**Step 1:** Order the data. Find the median and the quartiles.

<table>
<thead>
<tr>
<th>lower half</th>
<th>upper half</th>
</tr>
</thead>
<tbody>
<tr>
<td>least value</td>
<td>greater value</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>20</td>
<td>median, 14</td>
</tr>
</tbody>
</table>

**Step 2:** Draw a number line that includes the least and the greatest values. Graph points above the number line that represent the five-number summary.

**Step 3:** Draw a box using the quartiles. Draw a line through the median. Draw whiskers from the box to the least and the greatest values.

**Exercises:**

Make a box-and-whisker plot for the data.

9. Ages of volunteers at a hospital: 14, 17, 20, 16, 17, 14, 21, 18

10. Masses (in kilograms) of lions: 120, 200, 180, 150, 200, 200, 230, 160
Make a stem-and-leaf plot of the data.

1. **Quiz Scores (%)**
   - 96 88 80 72
   - 80 94 92 100
   - 76 80 68 90

2. **CDs Sold Each Day**
   - 45 31 29 38 38
   - 67 40 62 45 60
   - 40 39 60 43 48

3. Find the mean, median, mode, range, and interquartile range of the data.
   - **Cooking Time (minutes)**
     - Stem | Leaf
     - 3    | 5 8
     - 4    | 0 1 8
     - 5    | 0 4 4 4 5 9
     - 6    | 0
   - Key: 41 = 41 minutes

4. Display the data in a histogram.
   - **Television Watched Per Week**
     - Hours | Frequency
     - 0–9   | 14
     - 10–19 | 16
     - 20–29 | 10
     - 30–39 | 8

5. **WATER** The dot plot shows the number of glasses of water that the students in a class drink in one day.
   - a. Describe the shape of the distribution.
   - b. Choose the most appropriate measures to describe the center and the variation. Find the measures you chose.

6. Make a box-and-whisker plot for the data.
   - 6. Ages (in years) of dogs at a vet’s office: 1, 3, 5, 11, 5, 7, 5, 9
   - 7. Lengths (in inches) of fish in a pond: 12, 13, 7, 8, 14, 6, 13, 10
   - 8. Hours practiced each week: 7, 6, 5, 4.5, 3.5, 7, 7.5, 2, 8, 7, 7.5, 6.5

9. **CELL PHONES** The double box-and-whisker plot compares the battery life (in hours) of two brands of cell phones.
   - a. What is the range of the upper 75% of each brand?
   - b. Which battery has a longer battery life? Explain.
1. Research scientists are measuring the number of days lettuce seeds take to germinate. In a study, 500 seeds were planted. Of these, 473 seeds germinated. The box-and-whisker plot summarizes the number of days it took the seeds to germinate. What can you conclude from the box-and-whisker plot?

A. The median number of days for the seeds to germinate is 12.
B. 50% of the seeds took more than 8 days to germinate.
C. 50% of the seeds took less than 5 days to germinate.
D. The median number of days for the seeds to germinate was 6.

2. You are comparing the costs of buying bottles of water at the supermarket. Which of the following has the least cost per liter?

F. six 1-liter bottles for $1.80
G. one 2-liter bottle for $0.65
H. eight \( \frac{1}{2} \)-liter bottles for $1.50
I. twelve \( \frac{1}{2} \)-liter bottles for $1.98

3. What number belongs in the box to make the equation true?

\[ \frac{3}{2} \div \frac{5}{3} = \frac{7}{2} \times \square \]

A. \( \frac{17}{3} \)
B. \( \frac{13}{2} \)
C. \( \frac{3}{17} \)
D. \( \frac{3}{2} \)
4. What is the mean number of seats?

<table>
<thead>
<tr>
<th>Number of seats</th>
<th>Seats in an SUV</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

F. 2.4 seats  
G. 5 seats  
H. 6.5 seats  
I. 7 seats

5. On Wednesday, the town of Mims received 17 millimeters of rain. This was $x$ millimeters more rain than the town received on Tuesday. Which expression represents the amount of rain, in millimeters, the town received on Tuesday?

A. $17x$  
B. $17 - x$  
C. $x + 17$  
D. $x - 17$

6. One of the leaves is missing in the stem-and-leaf plot.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 4</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4 5 7 7 7 ? 9</td>
</tr>
<tr>
<td>4</td>
<td>0 1 1 4</td>
</tr>
<tr>
<td>5</td>
<td>0 2 3</td>
</tr>
</tbody>
</table>

Key: 1|4 = 14

The median of the data set represented by the stem-and-leaf plot is 38. What is the value of the missing leaf?

7. Which property is demonstrated by the equation below?

$$723 + (884 + 277) = 723 + (277 + 884)$$

F. Associative Property of Addition  
G. Commutative Property of Addition  
H. Distributive Property  
I. Identity Property of Addition
8. A student took 5 tests this marking period and had a mean score of 92. Her scores on the first 4 tests were 90, 96, 86, and 92. What was her score on the fifth test?

A. 92  
B. 93  
C. 96  
D. 98

9. At the end of the school year, your teacher counted up the number of absences for each student. The results are shown in the histogram below.

Based on the histogram, how many students had fewer than 10 absences?

10. The 16 members of a camera club have the ages listed below.

40, 22, 24, 58, 30, 31, 37, 25, 62, 40, 39, 37, 28, 28, 51, 44

Part A  Order the ages from least to greatest.

Part B  Find the median of the ages.

Part C  Make a box-and-whisker plot for the ages of the camera club members.