11.5 Choosing a Data Display

Essential Question How can you display data in a way that helps you make decisions?

EXPLORATION 1 **Displaying Data**

Work with a partner. Analyze the data and then create a display that best represents the data. Explain your choice of data display.

a. A group of schools in New England participated in a 2-month study and reported 3962 animals found dead along roads.

birds: 307   mammals: 2746   amphibians: 145

reptiles: 75   unknown: 689

b. The data below show the numbers of black bears killed on a state's roads from 1993 to 2012.

1993: 30	2000: 47	2007: 99
1994: 37	2001: 49	2008: 129
1995: 46	2002: 61	2009: 111
1996: 33	2003: 74	2010: 127
1997: 43	2004: 88	2011: 141
1998: 35	2005: 82	2012: 135
1999: 43	2006: 109	

c. A 1-week study along a 4-mile section of road found the following weights (in pounds) of raccoons that had been killed by vehicles.

13.4	14.8	17.0	12.9	21.3	21.5	16.8	14.8
15.2	18.7	18.6	17.2	18.5	9.4	19.4	15.7
14.5	9.5	25.4	21.5	17.3	19.1	11.0	12.4
20.4	13.6	17.5	18.5	21.5	14.0	13.9	19.0

d. A yearlong study by volunteers in California reported the following numbers of animals killed by motor vehicles.

raccoons: 1693   gray squirrels: 715

skunks: 1372   cottontail rabbits: 629

ground squirrels: 845   barn owls: 486

opossum: 763   jackrabbits: 466

deer: 761   gopher snakes: 363

USING TOOLS STRATEGICALLY

To be proficient in math, you need to identify relevant external mathematical resources.

Communicate Your Answer

2. How can you display data in a way that helps you make decisions?

3. Use the Internet or some other reference to find examples of the following types of data displays.

bar graph   circle graph   scatter plot

stem-and-leaf plot   pictograph   line graph

box-and-whisker plot   histogram   dot plot

11.5 Lesson

Core Vocabulary

qualitative (categorical) data,
   p. 618
quantitative data, *p. 618*
misleading graph, *p. 620*

STUDY TIP

Just because a frequency count can be shown for a data set does not make it quantitative. A frequency count can be shown for both qualitative and quantitative data.

What You Will Learn

▶ Classify data as quantitative or qualitative.

▶ Choose and create appropriate data displays.

▶ Analyze misleading graphs.

Classifying Data

Data sets can consist of two types of data: *qualitative* or *quantitative*.

Core Concept

Types of Data

Qualitative data, or **categorical data**, consist of labels or nonnumerical entries that can be separated into different categories. When using qualitative data, operations such as adding or finding a mean do not make sense.

Quantitative data consist of numbers that represent counts or measurements.

EXAMPLE 1   **Classifying Data**

Tell whether the data are *qualitative* or *quantitative*.

a. prices of used cars at a dealership   **b.** jersey numbers on a basketball team

c. lengths of songs played at a concert   **d.** zodiac signs of students in your class

SOLUTION

a. Prices are numerical entries. So, the data are quantitative.

b. Jersey numbers are numerical, but they are labels. It does not make sense to compare them, and you cannot measure them. So, the data are qualitative.

c. Song lengths are numerical measurements. So, the data are quantitative.

d. Zodiac signs are nonnumerical entries that can be separated into different categories. So, the data are qualitative.

Monitoring Progress   🔊 Help in English and Spanish at *BigIdeasMath.com*

Tell whether the data are *qualitative* or *quantitative*. Explain your reasoning.

1. telephone numbers in a directory   **2.** ages of patients at a hospital

3. lengths of videos on a website   **4.** types of flowers at a florist

Qualitative and quantitative data can be collected from the same data source, as shown below. You can use these types of data together to obtain a more accurate description of a population.

Data Source	Quantitative Data	Qualitative Data
a student	How much do you earn per hour at your job? $10.50	What is your occupation? painter
a house	How many square feet of living space is in the house? 2500 ft^2	In what city is the house located? Chicago

Choosing and Creating Appropriate Data Displays

As shown on page 584, you have learned a variety of ways to display data sets graphically. Choosing an appropriate data display can depend on whether the data are qualitative or quantitative.

EXAMPLE 2 **Choosing and Creating a Data Display**

Analyze the data and then create a display that best represents the data. Explain your reasoning.

a.

Eye Color Survey	
Color	Number of students
brown	63
blue	37
hazel	25
green	10
gray	3
amber	2

b.

| Speeds of Vehicles (mi/h)			
Interstate A		Interstate B	
65	67	67	72
68	71	70	78
72	70	65	71
68	65	71	80
65	68	84	81
75	82	77	79
68	59	69	70
62	68	66	69
75	80	73	75
77	75	84	79

SOLUTION

a. A circle graph is one appropriate way to display this qualitative data. It shows data as parts of a whole.

Step 1 Find the angle measure for each section of the circle graph by multiplying the fraction of students who have each eye color by 360°. Notice that there are $63 + 37 + 25 + 10 + 3 + 2 = 140$ students in the survey.
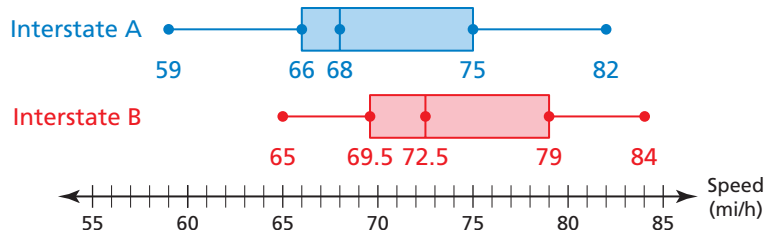
Brown: $\frac{63}{140} \cdot 360° \approx 162°$ **Blue:** $\frac{37}{140} \cdot 360° \approx 95°$ **Hazel:** $\frac{25}{140} \cdot 360° \approx 64°$

Green: $\frac{10}{140} \cdot 360° \approx 26°$ **Gray:** $\frac{3}{140} \cdot 360° \approx 8°$ **Amber:** $\frac{2}{140} \cdot 360° \approx 5°$

Step 2 Use a protractor to draw the angle measures found in Step 1 on a circle. Then label each section and title the circle graph, as shown.

Eye Color Survey

Green: 10 — Gray: 3 — Amber: 2
Hazel: 25
Brown: 63
Blue: 37
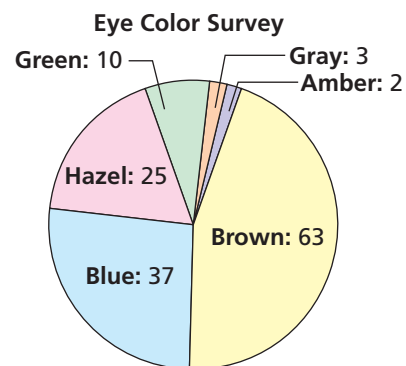
b. A double box-and-whisker plot is one appropriate way to display this quantitative data. Use the five-number summary of each data set to create a double box-and-whisker plot.

Interstate A: 59   66 68   75   82

Interstate B: 65   69.5 72.5   79   84

Speed (mi/h)

55   60   65   70   75   80   85

5. Display the data in Example 2(a) in another way.

6. Display the data in Example 2(b) in another way.
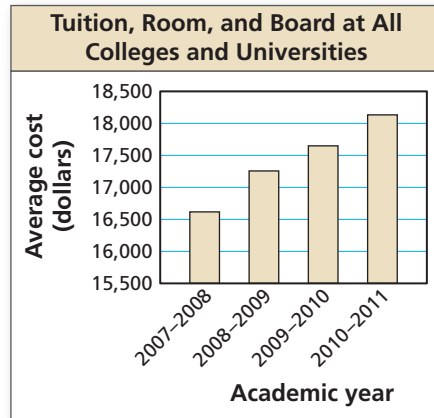
Analyzing Misleading Graphs

Just as there are several ways to display data accurately using graphs, there are several ways to display data that are misleading. A **misleading graph** is a statistical graph that is not drawn appropriately. This may occur when the creator of a graph wants to give viewers the impression that results are better than they actually are. Below are some questions you can ask yourself when analyzing a statistical graph that will help you recognize when a graph is trying to deceive or mislead.

- Does the graph have a title?
- Are the numbers of the scale evenly spaced?
- Does the scale begin at zero? If not, is there a break?

- Does the graph need a key?
- Are all the axes or sections of the graph labeled?
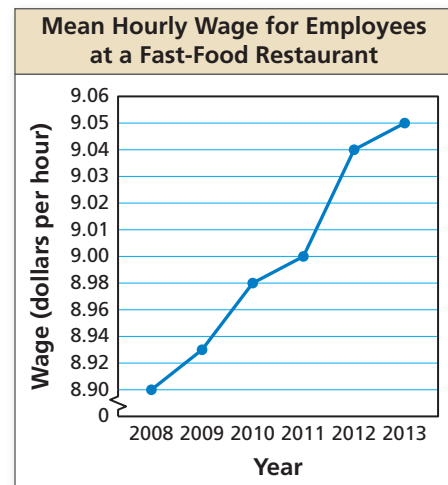- Are all the components of the graph, such as the bars, the same size?

EXAMPLE 3 **Analyzing Misleading Graphs**

Describe how each graph is misleading. Then explain how someone might misinterpret the graph.

a.

Tuition, Room, and Board at All Colleges and Universities

b.

Mean Hourly Wage for Employees at a Fast-Food Restaurant

SOLUTION

a. The scale on the vertical axis of the graph starts at $15,500 and does not have a break. This makes it appear that the average cost increased rapidly for the years given.

Someone might believe that the average cost more than doubled from 2007 to 2011, when actually, it increased by only about $1500.

b. The scale on the vertical axis has very small increments that are not equal.

Someone might believe that the greatest increase in the mean hourly wage occurred from 2011 to 2012, when the greatest increase actually occurred from 2009 to 2010.

7. Redraw the graphs in Example 3 so they are not misleading.

Vocabulary and Core Concept Check

1. **OPEN-ENDED** Describe two ways that a line graph can be misleading.

2. **WHICH ONE DOESN'T BELONG?** Which data set does *not* belong with the other three? Explain your reasoning.

ages of people attending a concert	heights of skyscrapers in a city
populations of counties in a state	breeds of dogs at a pet store

Monitoring Progress and Modeling with Mathematics

In Exercises 3–8, tell whether the data are *qualitative* or *quantitative*. Explain your reasoning. *(See Example 1.)*

3. brands of cars in a parking lot

4. weights of bears at a zoo

5. budgets of feature films

6. file formats of documents on a computer

7. shoe sizes of students in your class

8. street addresses in a phone book

In Exercises 9–12, choose an appropriate data display for the situation. Explain your reasoning.

9. the number of students in a marching band each year

10. a comparison of students' grades (out of 100) in two different classes

11. the favorite sports of students in your class

12. the distribution of teachers by age

In Exercises 13–16, analyze the data and then create a display that best represents the data. Explain your reasoning. *(See Example 2.)*

13.

Ages of World Cup Winners	
2010 Men's World Cup Winner (Spain)	**2011 Women's World Cup Winner (Japan)**
29 24 23 30 32 26 28 30 26 23 32 28 22 28 24 21 27 22 25 21 24 24 27	36 27 24 20 27 23 29 26 25 32 27 27 22 25 24 23 24 28 20 18 24

14.

Average Precipitation (inches)			
January	1.1	July	4.0
February	1.5	August	4.4
March	2.2	September	4.2
April	3.7	October	3.5
May	5.1	November	2.1
June	5.5	December	1.8

15.

Grades (out of 100) on a Test				
96	74	97	80	62
84	88	53	77	75
89	81	52	85	63
87	95	59	83	100

16.

Colors of Cars that Drive by Your House			
white	25	green	3
red	12	silver/gray	27
yellow	1	blue	6
black	21	brown/biege	5

17. **DISPLAYING DATA** Display the data in Exercise 13 in another way.

18. **DISPLAYING DATA** Display the data in Exercise 14 in another way.

19. **DISPLAYING DATA** Display the data in Exercise 15 in another way.

**20. DISPLAYING DATA** Display the data in Exercise 16 in another way.

In Exercises 21–24, describe how the graph is misleading. Then explain how someone might misinterpret the graph. *(See Example 3.)*

21.

Annual Sales

22.

**Bicycling**

23.

24.

Decaying Chemical Compound
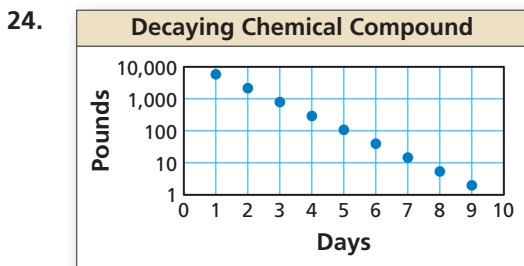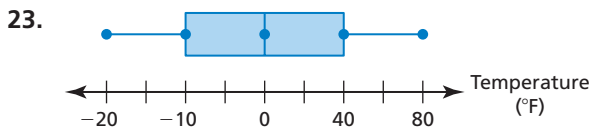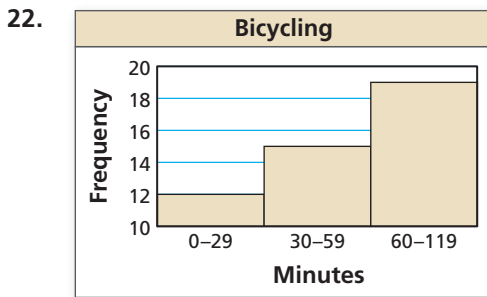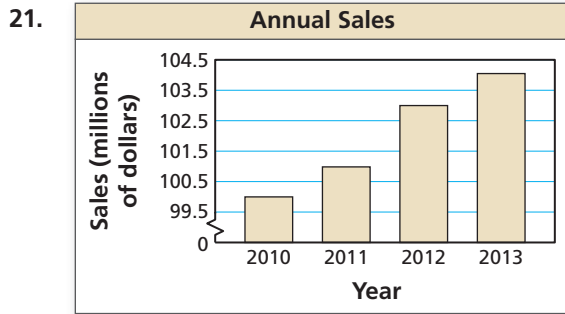
25. DISPLAYING DATA Redraw the graph in Exercise 21 so it is not misleading.

26. DISPLAYING DATA Redraw the graph in Exercise 22 so it is not misleading.

27. MAKING AN ARGUMENT A data set gives the ages of voters for a city election. Classmate A says the data should be displayed in a bar graph, while Classmate B says the data would be better displayed in a histogram. Who is correct? Explain.

28. HOW DO YOU SEE IT? The manager of a company sees the graph shown and concludes that the company is experiencing a decline. What is missing from the graph? Explain why the manager may be mistaken.

Company Growth
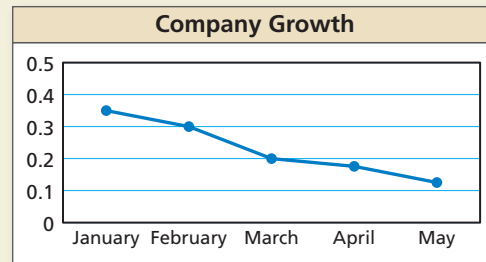
29. REASONING A survey asked 100 students about the sports they play. The results are shown in the circle graph.

Sports Played
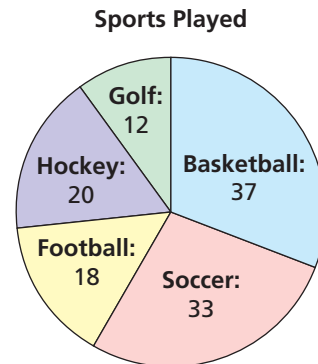
a. Explain why the graph is misleading.

b. What type of data display would be more appropriate for the data? Explain.

30. THOUGHT PROVOKING Use a spreadsheet program to create a type of data display that is not used in this section.

31. REASONING What type of data display shows the mode of a data set?

Maintaining Mathematical Proficiency   *Reviewing what you learned in previous grades and lessons*

Determine whether the relation is a function. Explain. *(Section 3.1)*

32. $(-5, -1), (-6, 0), (-5, 1), (-2, 2), (3, 3)$

33. $(0, 1), (4, 0), (8, 1), (12, 2), (16, 3)$