

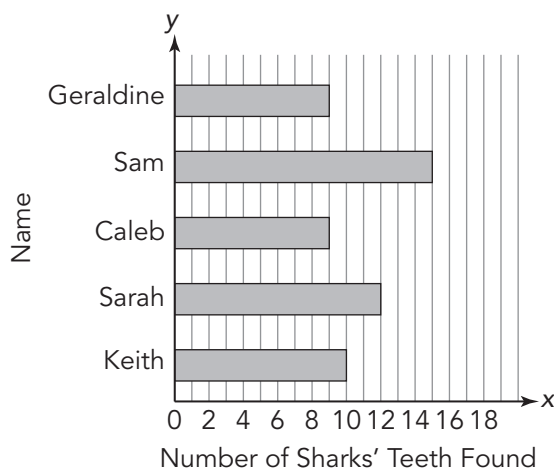
Skyscrapers

3

Using Histograms to Display Data

WARM UP

Use the bar graph to answer each question.



1. Who found the most sharks' teeth? How many did that person find?
2. How many total sharks' teeth did the friends find?

LEARNING GOALS

- Display and interpret numerical data in histograms.
- Compare data displays.

KEY TERMS

- histogram
- grouped frequency table

You have used dot plots and stem-and-leaf plots, which are good for small data sets. How can you display data sets with a larger number of observations?

Getting Started

State Parks

There are over 6000 state parks in the United States. The table shows how many state parks there are in each of the states listed.

State	Number of Parks
Colorado	42
Arizona	30
Nevada	24
Georgia	66
Tennessee	56
Alabama	27
Vermont	57
New Hampshire	75
Rhode Island	23

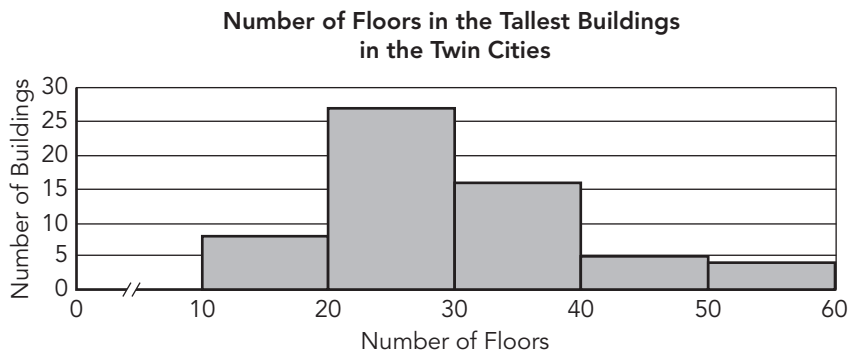
1. Create a bar graph using the data in the table.
2. Create another bar graph with the states in alphabetical order. How is this bar graph different from your previous bar graph?
3. Suppose you wanted to graph state parks according to the region of the country. How would your bar graph be different?

The remainder of this lesson is about *histograms*, which look similar to bar graphs.



Minneapolis and St. Paul are known as the Twin Cities because they are close to each other in Minnesota. Both cities are home to flourishing downtowns with tall buildings.

1. Look at the graph shown.



- How is this graph different from the bar graphs you have used previously?
- What information does the histogram display? Describe the data represented in the histogram shown. Look at the title and the labels on the axes.
- Are the data represented in the histogram discrete or continuous? Explain your reasoning.

2. Describe the distribution of the data in terms of the overall shape and the existence of peaks, clusters, and gaps.

The graph shown is a *histogram*.

A **histogram** is a graphical way to display quantitative or numerical data using vertical bars.

The width of a bar in a histogram represents an interval of data and is often referred to as a bin.

The height of the bar indicates the frequency, or the number of data values included in any given bin.



What statistical question might have led to the collection of this data?



The first vertical bar in the histogram represents 8 buildings that have at least 10 floors but fewer than 20 floors.

3. Let's think about how the bars are displayed in the histogram.

a. How many bins are shown?

b. Are all the bins the same size?

c. What does the height of each bar represent?

4. Describe the range of floors included in each of the remaining bins shown on the horizontal axis.

- **2nd bin: interval 20–30**

- **3rd bin: interval 30–40**

- **4th bin: interval 40–50**

- **5th bin: interval 50–60**

5. If a new building was constructed that had 20 floors, which bin would change? How would it change?



In the second bin, the numbers 20 and 30 are called the *bounds* of the bin. What are the bounds of the 5th bin?



6. Bella says, "There are 5 buildings represented in the histogram since there are 5 bars." Do you agree or disagree with Bella's statement? If you do not agree with Bella, estimate how many buildings are represented in the histogram.



Dot plots show individual data values. Histograms display grouped data.

7. Can you determine how many buildings have 31 floors? Explain your reasoning.

8. Is it possible to determine the number of buildings that have more than 35 floors from the histogram? Why or why not?



9. Is it possible to determine the range of the data set from the histogram? Why or why not?



ACTIVITY
3.2

Creating and Analyzing Histograms



New York City has over 5800 tall buildings and is home to the fifth tallest building in the United States, the Empire State Building, which is 381 meters tall. Not to be outdone, Chicago is home to the Willis Tower, formerly known as Sears Tower. It stands an impressive 442 meters tall. So how do these big cities stack up to each other? Are there any similarities or differences in the number of floors each city's 20 tallest buildings have?

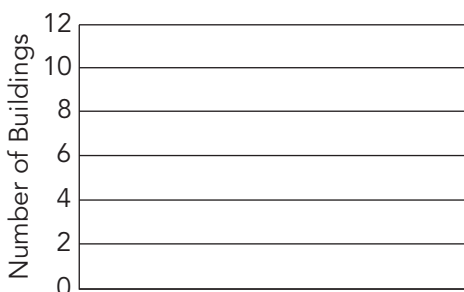
The tables listing each city's 20 tallest buildings are provided at the end of the lesson. Use the tables to create grouped frequency tables and histograms for each city's tallest buildings.

- Complete the grouped frequency tables for the number of floors in each city's 20 tallest buildings. Then complete the histograms. Make sure that you name your tables and histograms.**

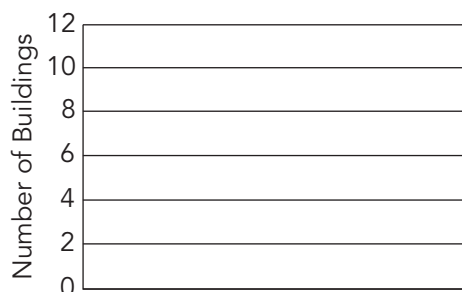
Remember, if a data value lies on one of the bounds, it should go in the bin to the right of that bound.

Number of Floors	Frequency (f)

Number of Floors	Frequency (f)



Number of Floors



Number of Floors

2. What is similar about the histograms? What are the differences between the two histograms?

3. Use what you know about the distributions and patterns of a graphical display to describe what the histograms say about the number of floors in each city's 20 tallest buildings.

ACTIVITY
3.3

Creating a Histogram with Continuous Data



Each year, the Empire State Building Run-Up (ESBRU) challenges runners to race up its stairs. You surveyed runners about their times at the end of the Run-Up. The results are shown in the table.

Amount of Time to Complete the ESBRU (minutes)					
10.4	11.25	15.76	9.81	12.05	18.2
10.52	13.73	13.01	12.75	14.99	11.24
15.0	15.57	16.6	14.8	13.35	12.22

1. Is the data in the table discrete or continuous?
Explain your reasoning.

Shania and Trinh decide to make a histogram for the data set.
The intervals they each want to use for the histogram are shown.

Trinh 


9-10

11-12

13-14

15-16

17-18

Shania 

9-10.9

11-12.9

13-14.9

15-16.9

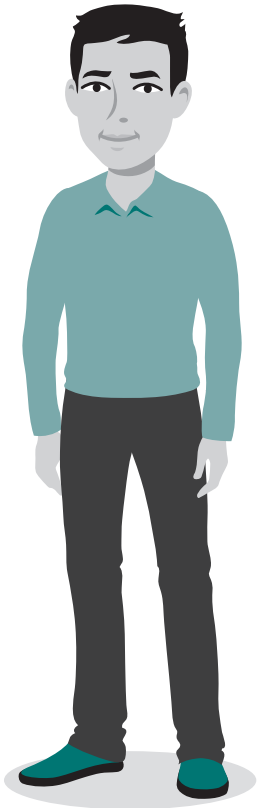
17-18.9

**2. Explain why both Trinh's and Shania's intervals are incorrect.
Use a data value from the table to explain.**

“

Changing the size of the intervals allows you to manipulate how the data display appears.

”



3. Create a grouped frequency table and histogram for the amount of time to complete the ESBRU.

4. Create a second grouped frequency table and histogram for the amount of time to complete the ESBRU. Use a different bin width than you used in Question 3. What do you notice?

5. What conclusions can you make about the amount of time it takes to complete the Empire State Building Run-Up? Use what you know about distributions and patterns of graphical displays.

TALK the TALK

Which Plot Is Best?

Throughout this topic, you have created and analyzed a variety of numerical data displays.

1. List at least one advantage and one disadvantage of using each type of plot to display numerical data.

	Advantage (or Use)	Disadvantage (or Limitation)
dot plot		
stem-and-leaf plot		
histogram		

Use with Activity 3.2, Creating and Analyzing Histograms

New York City's 20 Tallest Buildings	
Name of Building	Number of Floors
One World Trade Center	104
432 Park Avenue	89
Empire State Building	103
Bank of America Tower	54
Three World Trade Center	80
Chrysler Building	77
The New York Times Building	52
One57	75
Four World Trade Center	74
70 Pine Street	66
30 Park Place	82
40 Wall Street	70
Citigroup Center	59
10 Hudson Yards	52
8 Spruce Street	76
Trump World Tower	72
30 Rockefeller Center	70
56 Leonard Street	57
CitySpire Center	75
28 Liberty Street	60

Chicago's 20 Tallest Buildings	
Name of Building	Number of Floors
Willis Tower	108
Trump International Hotel and Tower	98
Aon Center	83
John Hancock Center	100
Franklin Center North Tower	61
Two Prudential Plaza	64
311 South Wacker Drive	65
900 North Michigan	66
Water Tower Place	74
Aqua	82
Chase Tower	60
Park Tower	67
The Legacy at Millennium Park	73
300 North LaSalle	60
Three First National Plaza	57
Grant Thornton Tower	50
Blue Cross Blue Shield Tower	57
One Museum Park	62
Olympia Centre	63
330 North Wabash	52

Assignment

Write

Write a definition for each term in your own words.

1. histogram
2. grouped frequency table

Remember

Histograms are used when the data is numerical. Numerical data can be represented continuously in intervals.

The intervals in a histogram must all be the same size. The width of the bar represents the interval. The height of the bar indicates the frequency of values in the interval.

Practice

Jeremy's scores for the first 20 times he played the card game, *Clubs and Swords*, are listed.
50, 199, 246, 356, 89, 210, 391, 325, 273, 260, 100, 172, 123, 167, 194, 172, 23, 426, 75, 239

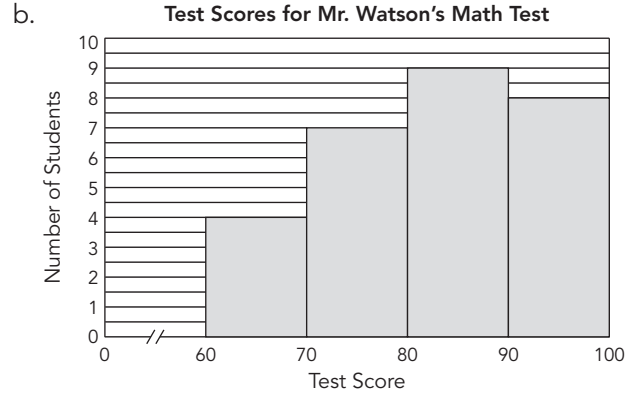
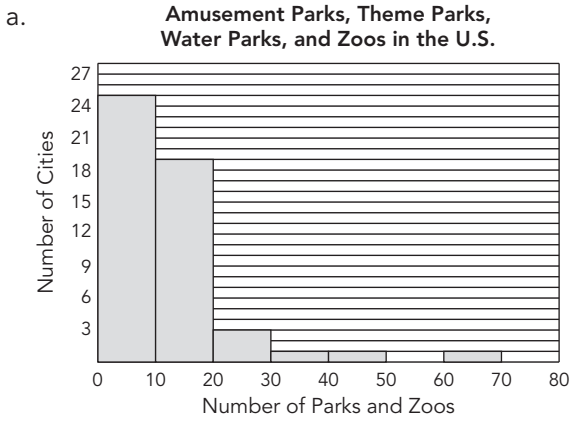
1. Create a frequency table and a histogram to display Jeremy's scores. Be sure to name your histogram.
2. Describe the distribution of the data. Include any specific graphical features or patterns. Explain what your answer means in terms of Jeremy's scores.
3. Create a second frequency table and histogram to provide a different view of the data distribution.

Stretch

Aviana claims that she can turn any stem-and-leaf plot into a histogram. Is she correct? Provide an example or a counterexample.

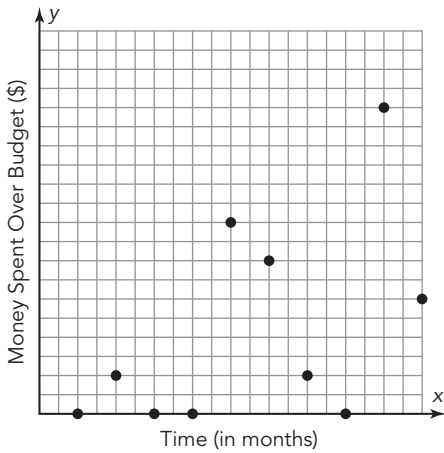
Review

1. Describe the shape of each histogram.



2. A free diver is diving at a constant rate of 0.75 feet per second. Write and graph an equation that represents the situation.

3. Tell a story to describe the graph.



4. Determine the absolute value of each number.

a. $|-4.2|$

b. $\left|11\frac{7}{8}\right|$