



Solve & Discuss It!



ACTIVITY

What is the cost of 10 bottles of fruit juice?



Lesson 5-5

Understand Rates and Unit Rates



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I can...

solve problems involving rates.



Common Core Content Standards
6.R.P.A.2, 6.R.P.A.3a, 6.R.P.A.3b

Mathematical Practices
MP.1, MP.2, MP.3, MP.8

Make Sense and Persevere

How can you use tables or diagrams to make sense of the quantities in the problem? © MP.1

Focus on math practices

Critique Reasoning Monica says, "If 4 bottles cost \$10, then 2 bottles cost \$5, and 8 bottles cost \$20. So 10 bottles cost \$5 + \$20." Is Monica correct? Explain. © MP.3



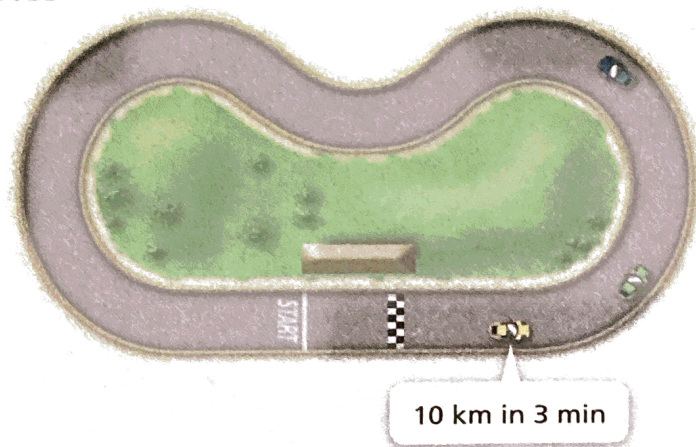
EXAMPLE 1 Find Equivalent Rates

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A rate is a special type of ratio that compares quantities with unlike units of measure.

If the race car continues to travel at the same rate, how long will it take it to travel 25 kilometers?

Generalize You can find equivalent rates the same ways that you find equivalent ratios. © MP.8



ONE WAY Use a ratio table to find rates that are equivalent to $\frac{10 \text{ km}}{3 \text{ min}}$.

Distance (km)	Time (min)
5	$1\frac{1}{2}$
10	3
15	$4\frac{1}{2}$
20	6
25	$7\frac{1}{2}$

It will take the race car $7\frac{1}{2}$ minutes to travel 25 kilometers.

ANOTHER WAY Write the rate as a fraction. Multiply both terms of the rate by the same number to find an equivalent rate.

Think, $10 \times ? = 25$.

$$\frac{10 \text{ km}}{3 \text{ min}} = \frac{25 \text{ km}}{x \text{ min}}$$

$$\frac{10 \text{ km} \times 2.5}{3 \text{ min} \times 2.5} = \frac{25 \text{ km}}{7.5 \text{ min}}$$

Multiply both terms by 2.5.

It will take the race car 7.5 minutes to travel 25 kilometers.

Try It!

At the same rate, how long would it take the car to travel 60 kilometers?

It will take the car minutes to travel kilometers.

$$\frac{10 \text{ km} \times \square}{3 \text{ min} \times \square} = \frac{60 \text{ km}}{\square \text{ min}}$$



A rate compares quantities with unlike units of measure.

$$\frac{\$3.50}{7 \text{ oranges}}$$

A unit rate compares a quantity to 1 unit of another quantity.

$$\frac{\$3.50}{7 \text{ oranges}} = \frac{\$0.50}{1 \text{ orange}}$$

Do You Understand?

1. **Essential Question** What are rates and unit rates?

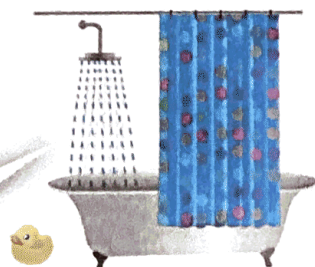
2. **Be Precise** Use what you know about ratios to describe a rate. © MP.6

3. **Reasoning** A bathroom shower streams 5 gallons of water in 2 minutes. © MP.2

a. Find the unit rate for gallons per minute and describe it in words.

b. Find the unit rate for minutes per gallon and describe it in words.

5 gallons in two minutes



Do You Know How?

In 4 and 5, find the value of n .

4.

Miles	45	135
Hours	4	n



6. Jenny packaged 108 eggs in 9 cartons. Write this statement as a rate.

7. Anna Maria read 40 pages in 60 minutes. What is her unit rate in pages per minute?

In 8 and 9, use the unit rates that you found in Exercise 3.

8. How many gallons of water does the shower stream in 6 minutes?

9. How long can someone shower to use only 10 gallons of water?



Practice & Problem Solving



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In 10 and 11, write each statement as a rate.

10. Jan saw 9 full moons in 252 days.

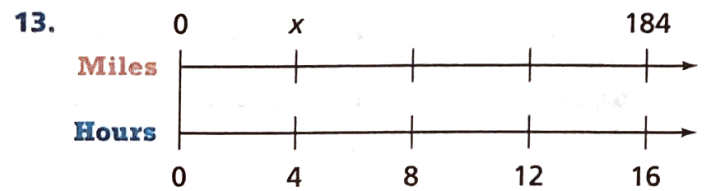
11. It took Hannah 38 minutes to run 8 laps.



In 12 and 13, find the value of x .

12.

Fish	16	48
Bowls	2	x



Leveled Practice In 14 and 15, find the unit rate.

14. $\frac{320 \text{ mi}}{16 \text{ gal}}$

$$\frac{320 \div 16}{16 \div 16} = \frac{\boxed{}}{1}$$

$\frac{\boxed{} \text{ mi}}{1 \text{ gal}}$

15. $\frac{75 \text{ cm}}{5 \text{ h}}$

$$\frac{75 \div \boxed{}}{5 \div 5} = \frac{\boxed{}}{1}$$

$\frac{\boxed{} \text{ cm}}{1 \text{ h}}$

In 16–19, complete each table.

16.

Pages	9	<input type="text"/>	<input type="text"/>	<input type="text"/>
Minutes	18	1	10	15

17.

Beans	186	<input type="text"/>	<input type="text"/>	<input type="text"/>
Bags	3	1	7	11

18.

Ounces	<input type="text"/>	24.6	<input type="text"/>	123
Bags	1	2	5	<input type="text"/>

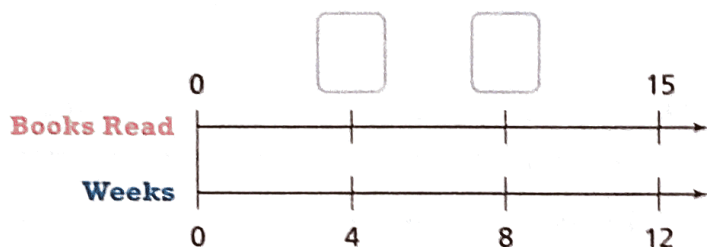
19.

Miles	25	<input type="text"/>	125	<input type="text"/>
Gallons	<input type="text"/>	3	5	12

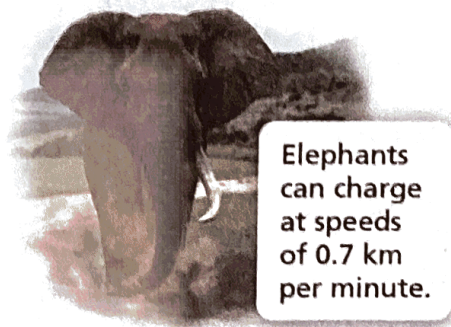
20. Which runner set the fastest pace? Explain.

Runner	Laps	Time
Martha	20	32 min
Allison	16	25 min
Rachel	17	27.2 min

21. **Model with Math** Over the summer, Alexis read 15 books in 12 weeks. The diagram below can be used to track her progress. If Alexis read at the same rate each week, how many books had she read in 4 weeks? In 8 weeks? Complete the diagram. © MP.4



22. An elephant charges an object that is 0.35 kilometer away. How long will it take the elephant to reach the object?



23. A machine takes 1 minute to fill 6 cartons of eggs. At this rate, how many minutes will it take to fill 420 cartons?

24. **Higher Order Thinking** How are the ratios $\frac{24 \text{ laps}}{1 \text{ hour}}$ and $\frac{192 \text{ laps}}{8 \text{ hours}}$ alike? How are they different?

© Assessment Practice

25. A cook mixes 4 pounds of rice into 5 quarts of boiling water. Choose all the statements that are true.

- $\frac{0.8 \text{ lb rice}}{1 \text{ qt water}}$ is a unit rate for the mix.
- $\frac{1.25 \text{ qt water}}{1 \text{ lb rice}}$ is a unit rate for the mix.
- Using the same rate, the cook should mix 12.5 pounds of rice with 10 quarts of water.
- Using the same rate, the cook should mix 10 pounds of rice with 12.5 quarts of water.
- Using the same rate, the cook should mix 2.5 pounds of rice with 2 quarts of water.

EXAMPLE 1 Use the Mean to Describe a Data Set


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Carla is in a bowling league. The league is ranking the teams by average score. What is the mean, or average, final score of the five bowlers on Carla's team?

The **mean**, or average, is the sum of all the values in a data set divided by the total number of data values in the set.

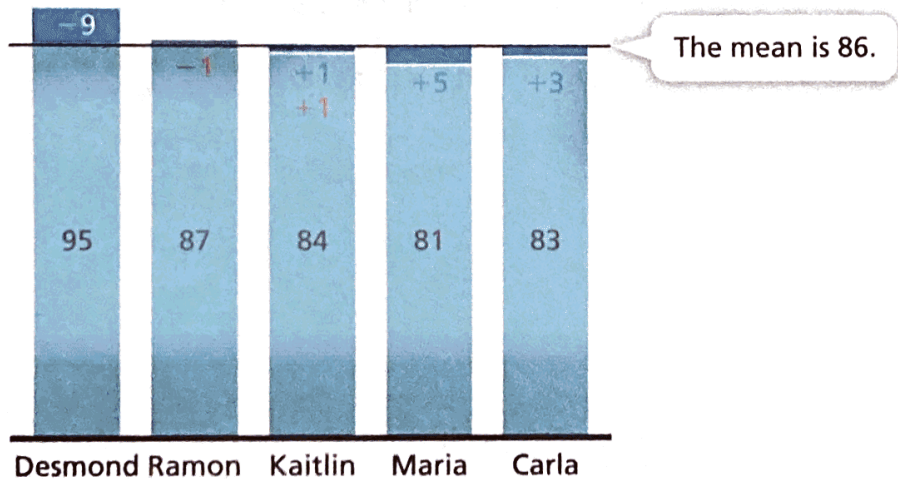
	9	10	FINAL SCORE
Desmond	86 7 2	95 6 3	95
Ramon	80 4 2	87 7 0	87
Kaitlin	77 5 1	84 4 3	84
Maria	74 2 4	81 5 2	81
Carla	75 3 3	83 6 2	83

Team Average \bar{x}



Generalize You can summarize a data set by using a mean. © MP.8

To find the mean, equally share the final scores among the five bowlers.



To calculate the mean, add the scores in the data set. Then divide the sum by the number of values in the data set.

$$\begin{array}{r}
 95 \\
 87 \\
 84 \\
 81 \\
 + 83 \\
 \hline
 430
 \end{array}
 \qquad
 \begin{array}{r}
 86 \\
 5 \overline{)430} \\
 \underline{-40} \\
 30 \\
 \underline{-30} \\
 0
 \end{array}$$

The mean, or average, final score is 86.

A mean is a measure of center. A measure of center summarizes a data set with a single value.

Try It!

The next week, Maria bowls a 151-point game. The other bowlers match their scores. What is the new mean final score for the team? Explain.

Convince Me! How did the mean final score change from the Example to the Try It!?



You can summarize a set of data using a measure of center, such as the mean, median, or mode, or a measure of variability, such as the range.

Mean

$$(7 + 10 + 16 + 9 + 12 + 21 + 14 + 8 + 13 + 15) \div 10 = 12.5$$

Median

7, 8, 9, 10, 12, 13, 14, 15, 16, 21

$$(12 + 13) \div 2 = 12.5$$

Mode

7, 8, 9, 10, 12, 13, 14, 15, 16, 21

There is no mode.

Range

7, 8, 9, 10, 12, 13, 14, 15, 16, 21

$$21 - 7 = 14$$

The average number of hours of TV watched each week is 12.5 hours.

The range of hours watched is 14 hours.

Number of Hours of TV Watched in a Week

Juan	7
Tyrone	10
Abigail	16
Lateisha	9
Helen	12
Albert	21
Tim	14
Josh	8
Anita	13
Henry	15

Do You Understand?

- Essential Question** How can you use a single measure to describe a data set?
- Maddie scored 3 goals, 2 goals, and 4 goals during her last three soccer games. How can you find the mean, or average, number of goals Maddie scored?
- Use Structure** Why is it important to order the data when finding the median? MP.7

Do You Know How?

The table shows data about the students in three classes.

Teacher	Boys	Girls
Ms. Green	15	14
Mr. Nesbit	12	12
Ms. Jackson	12	16

- What is the mean number of boys in the three classes? What is the mean number of girls in the three classes?
- What is the mode of the number of girls in the three classes?
- What is the median number of students in the three classes?

EXAMPLE 4



Use the Range to Describe a Data Set

Look at Trey's and Sarah's music libraries. What is the range of the playing times in each of their data sets?

The **range** is a measure of variability. A measure of variability describes how the values in a data set vary with a single number. The range is the difference of the greatest value and the least value.

Trey's Music Library

Music Type	Minutes
Blues	62
Classical	72
Country	61
Gospel	67
Jazz	67
Movie Soundtrack	63
Popular	59

Sarah's Music Library

Music Type	Minutes
Rock	37
Rap	42
Hip Hop	38
Bluegrass	46
New Age	51
Opera	35



Find the range for Trey's data set.

least value → (59) 61, 62, 63, 67, 67, (72) ← greatest value
 $72 - 59 = (13) \leftarrow \text{range}$

The range of playing times is 13 minutes.

Find the range for Sarah's data set.

least value → (35) 37, 38, 42, 46, (51) ← greatest value
 $51 - 35 = (16) \leftarrow \text{range}$

The range of playing times is 16 minutes.

EXAMPLE 5



Use the Mean, Median, Mode, and Range to Describe a Data Set

Seven people waited in line for the "Whirl and Twirl" carnival ride. Find the mean, median, mode, and range of the wait times for the carnival ride. What do the mean, median, and mode tell you about the wait times? What does the range, as a measure of variability, tell you about the wait times?

Mean: 13

Median: 13

Modes: 12 and 15

Range: 5

The mean, median, and mode each give a measure of the typical wait time for the ride. The mean and median wait times were 13 minutes. Two pairs each waited 12 or 15 minutes. The range uses a single number to describe how the wait times vary. The wait times vary by 5 minutes.

Carnival Ride Wait Times

Person	Wait time (min.)
A	12
B	12
C	15
D	10
E	14
F	15
G	13



Try It!

Find the mean, median, mode, and range for the following set of data.

4, 6, 8, 3, 2, 1, 0, 12, 9



Name: _____

Practice & Problem Solving



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In 7–10, use the data shown in the table to find each mean.

7. Technical marks from judges

8. Presentation marks from judges

9. Find the combined marks, or total score, awarded by each of the 7 judges. Record your answers in the table.

10. What is the mean total score awarded by the judges?

A U.S. Figure Skater's Scores			
Judge	Technical Marks	Presentation Marks	Total Score
A	5.9	5.4	<input type="text"/>
B	5.8	5.7	<input type="text"/>
C	5.8	5.6	<input type="text"/>
D	5.6	5.3	<input type="text"/>
E	5.9	5.5	<input type="text"/>
F	5.6	5.3	<input type="text"/>
G	6.0	5.7	<input type="text"/>

In 11–14, use the data in the table.

States Traveled To or Lived In
1, 3, 5, 2, 5, 2, 10, 7, 1, 2, 4, 1, 2, 7, 12

11. Order the data from least to greatest.

12. What are the median, mode, and range of the data?

13. **Use Structure** The student who traveled to 3 states visited 3 new states during a vacation. Does increasing the 3 to 6 change the median? If so, how? © MP.7

14. **Look for Relationships** Does increasing the 3 to 6 change the mode? If so, how? © MP.7

In 24–26, use the data table.

24. What are the median, mode, and range of these data?

25. What is the mean number of moons for the 8 planets, rounded to the nearest whole number?

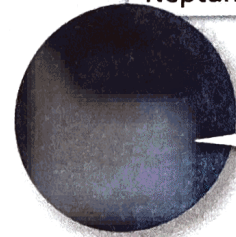
26. If you include Pluto's moons in the data, the median is 5.

a. How many moons does Pluto have? Explain.

b. Would including Pluto affect the range of the data? Explain.

Known Number of Moons of the Planets

Mercury	0
Venus	0
Earth	1
Mars	2
Jupiter	50
Saturn	53
Uranus	27
Neptune	13



Pluto is a dwarf planet.

27. **Higher Order Thinking** Is the median always, sometimes, or never one of the data values? Explain.

28. **Critique Reasoning** Maria says the mean of the scores 7, 8, 3, 0, 2 is 5, because she added the scores and divided by 4. Is she correct? Explain why or why not. © MP.3

© Assessment Practice

29. Use the data table to find the statistical measures. Draw a line to match each measure on the left to its value on the right.

mean

median

mode

range

\$257

\$265

\$269

\$299

Cost of Snowboards (\$) at Ski Shop

265
237
325
281
265
252
494
273

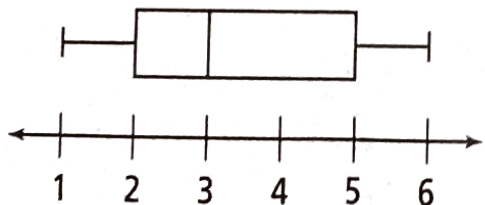


Do You Understand?

1. **Essential Question** Why is a box plot useful for representing certain types of data?

2. What values are included inside the box of a box plot?

3. **Critique Reasoning** A box plot shows the distribution of the costs of used books. The box of the box plot starts at \$2 and ends at \$5. Alex says this means that about one-quarter of the books cost between \$2 and \$5. Is Alex correct? Explain. © MP.3



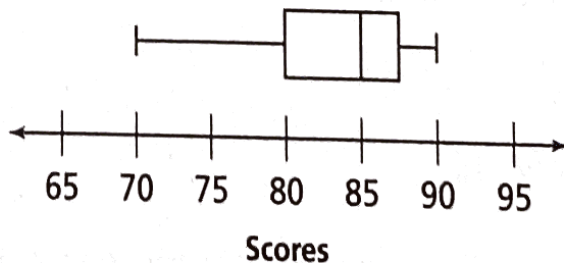
Do You Know How?

Sarah's scores on tests were 79, 75, 82, 90, 73, 82, 78, 85, and 78. In 4–8, use the data.

4. What are the minimum and maximum test scores?
5. Find the median.
6. Find the first and the third quartiles.
7. Draw a box plot that shows the distribution of Sarah's test scores.

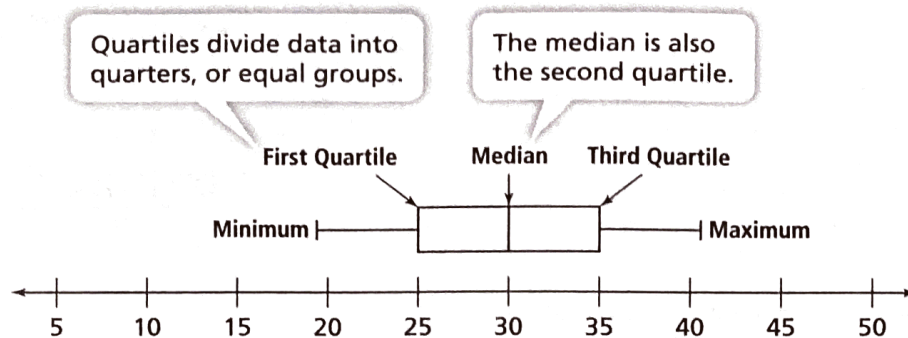
8. Eric is in Sarah's class. This box plot shows his scores on the same nine tests. How do Eric's scores compare to Sarah's?

Eric's Tests





A box plot shows a distribution of data values on a number line. A box plot visually represents a data set divided into four equal parts.

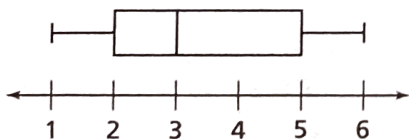


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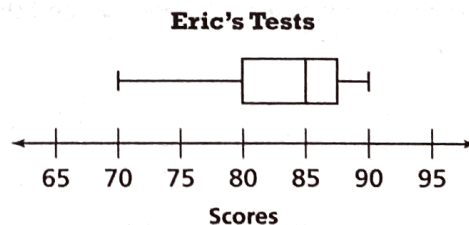
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- 17. Reasoning** The price per share of Electric Company's stock during 9 days, rounded to the nearest dollar, was as follows: \$16, \$17, \$16, \$16, \$18, \$18, \$21, \$22, \$19.

Use a box plot to determine how much greater the third quartile's price per share was than the first quartile's price per share. © MP.2

- 18. Make Sense and Persevere** The temperature forecast for Topeka, Kansas, for the next 8 days is shown. Use a box plot to determine the range for the lower half of the temperatures. © MP.1

DAILY HIGH TEMPERATURES							
SUN	MON	TUE	WED	THU	FRI	SAT	SUN
29°	31°	24°	26°	29°	35°	27°	32°

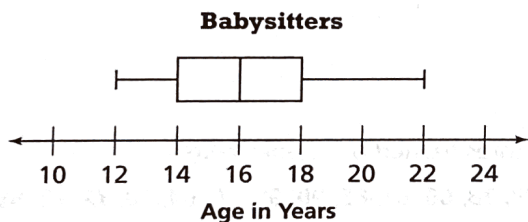
- 19. Model with Math** Coach Henderson clocked the speeds in miles per hour of pitches thrown during the first inning of a middle school baseball game, as shown at the right.

Draw a box plot to display the data and write two conclusions about the data shown in the box plot. © MP.4

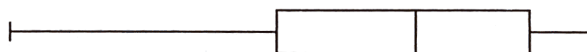
Speeds of Pitches Thrown (in miles per hour)

45.3 47 48.1 51.3 55.8 61.1 48.5 60.7 49

- 20. Critique Reasoning** Tanya recorded the ages of 10 local babysitters: 20, 16, 18, 13, 14, 13, 12, 16, 22, 18. She says that the box plot below shows the distribution of ages. What error did she make? © MP.3



- 21. Higher Order Thinking** Alana made this box plot to represent classroom attendance last month. Without seeing the values, what conclusions can you make about whether attendance was mostly high or low last month? Explain.



© Assessment Practice

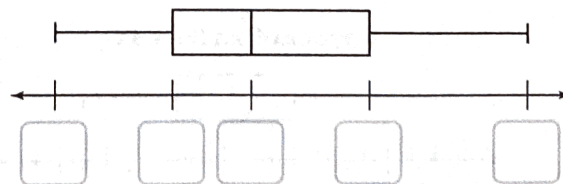
- 22.** Use the data given to complete the box plot.

The ages in years of the students in Caryn's gymnastics class are shown in the table.

Ages of Students in Years

12 11 9 18 10 11 7 16 14 11 6

Complete the box plot to show the distribution of the students' ages.



Explore It!



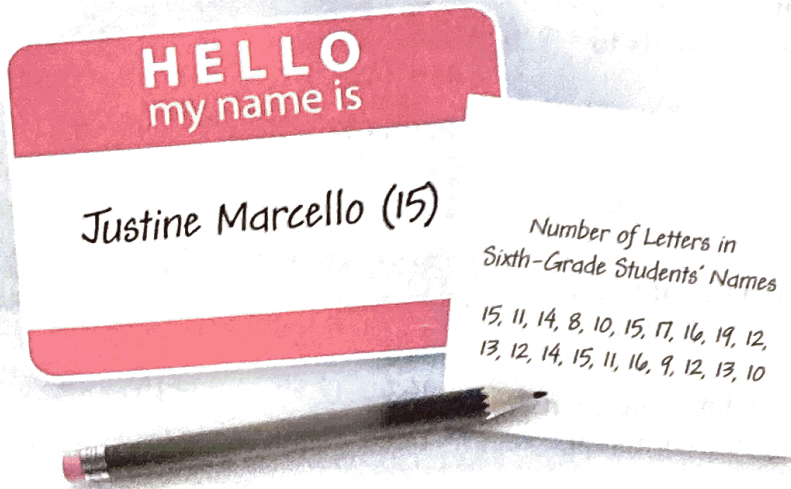
Lesson 8-4

Display Data in Frequency Tables and Histograms



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The students in a sixth-grade class recorded the number of letters in their first and last names combined.



I can...

make and analyze frequency tables and histograms.

© Common Core Content Standards
6.SP.B.4, 6.SP.B.5a

Mathematical Practices
MP.2, MP.4, MP.6, MP.7, MP.8

A. How can the data be organized? Describe one way to organize the data.

B. Describe another way to organize the data.

C. Compare the two ways. What do you notice about the data in each way?

Focus on math practices

Generalize What generalization can you make about the data set? © MP.8

Essential Question How can a frequency table or histogram help you organize and analyze data?



INTERACTIVE ANIMATION



ASSESS

EXAMPLE 1



Make a Frequency Table and a Histogram

Scan for Multimedia



Mr. Maxwell timed the cross-country team in a 2-mile run and recorded the times in the table shown. He wants to analyze the runners' times. What is one way that Mr. Maxwell can organize the data?

Team Times					
16:45	14:25	18:40	16:03	15:12	19:15
17:14	14:02	16:52	15:18	17:49	17:55

A **frequency table** shows the number of times a value occurs in each category or interval.

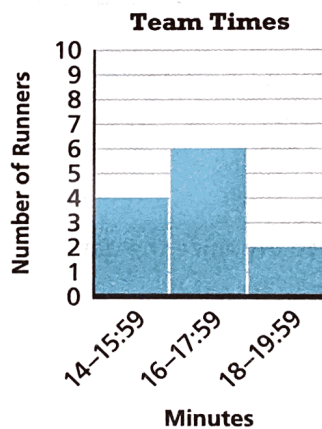
Mr. Maxwell can set up time intervals for the data, and then count the number, or frequency, of times for each interval.

Running Times	Tally	Frequency
14:00–15:59		4
16:00–17:59		6
18:00–19:59		2

Then he can use the frequency table to make a histogram.

Display the data by drawing a bar for each interval.

Look for Relationships How is a histogram similar to and different from a bar graph? © MP.7

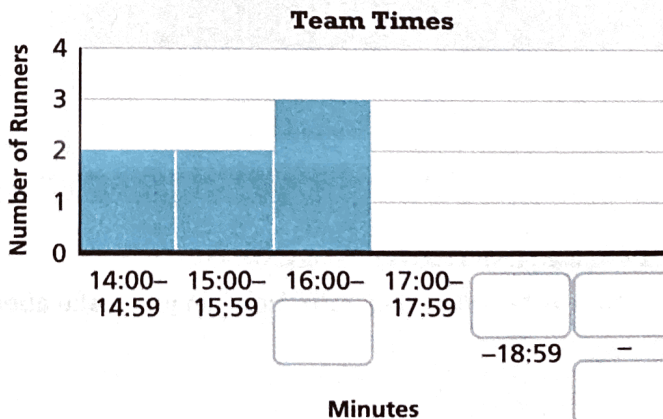


A **histogram** is a graph that uses bars to show the number of values in each category or interval.

The bars of a histogram always touch.

Try It!

This histogram shows a different way to represent Mr. Maxwell's data. Fill in the boxes with appropriate times and shade the bars for the last three intervals. How have the intervals changed?



Convince Me! How is the analysis of the information displayed different between the two histograms?



EXAMPLE 2**Use a Frequency Table to Solve Problems**

Zack surveys a group of middle school students and asks them how many texts they sent yesterday. The table shows the results.

- a. Is the greatest number of texts sent between 60 and 79?

The greatest frequency is 11, which corresponds to students who sent 60–79 texts. However, the greatest number of texts sent is between 80 and 99.

- b. Is the lowest number of texts sent between 20 and 39?

The lowest frequency is 4, which corresponds to students who sent 20–39 texts. However, the lowest number of texts sent is between 0 and 19.

Number of Texts	Tally	Frequency
0–19		5
20–39		4
40–59		10
60–79		11
80–99		8

**Try It!**

How many students sent between 20 and 59 texts?

EXAMPLE 3**Use a Histogram to Solve Problems**

The histogram shows the number of points that Kendra scored during each basketball game she played last season.

- a. How many games did Kendra play last season?

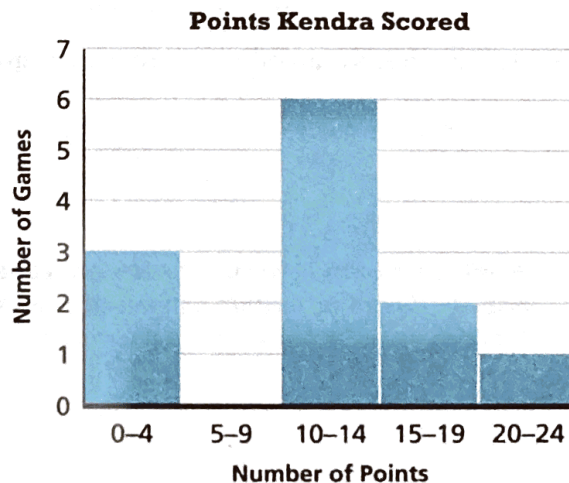
The total number of games can be found by adding the number of games shown by each bar.

$$3 + 0 + 6 + 2 + 1 = 12$$

Kendra played 12 games.

- b. In how many games did Kendra score from 5 to 9 points?

There is no bar on the histogram for 5–9 points. Kendra did not score 5–9 points in any games last season.

**Try It!**

Does the histogram show the mode of the number of points Kendra scored in the games? Explain.



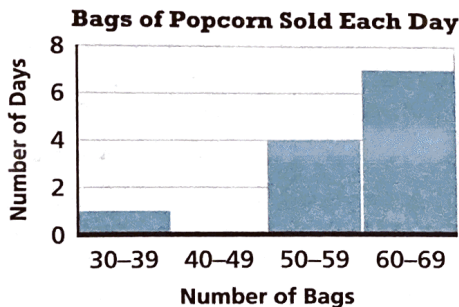
Data displays can be used to help make sense of data.

Bags of Popcorn Sold Each Day

62, 65, 58, 31, 64, 58, 66, 68, 56, 67, 68, 51

You can organize data in a frequency table.

Bags	Tally	Frequency
30-39		1
40-49		0
50-59		4
60-69		7



You can use a frequency table to make a histogram.

Do You Understand?

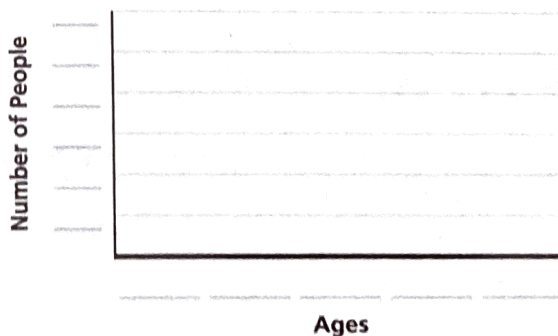
- Essential Question** How can a frequency table or histogram help you organize and analyze data?
- How is a histogram different from a bar graph?
- What types of numerical data sets are easier to display using a histogram instead of a dot plot? Explain.
- Reasoning** How are frequency tables and histograms alike and how are they different? © MP.2

Do You Know How?

- A data set contains ages ranging from 6 to 27.
6, 11, 9, 13, 18, 15, 21, 15, 17, 24, 27, 12
Complete the frequency table and histogram.

Ages	Tally	Frequency
6-10		
11-15		
16-20		
21-25		
26-30		

Ages in Data Set



Practice & Problem Solving



Leveled Practice In 6–11, use the data in the chart.

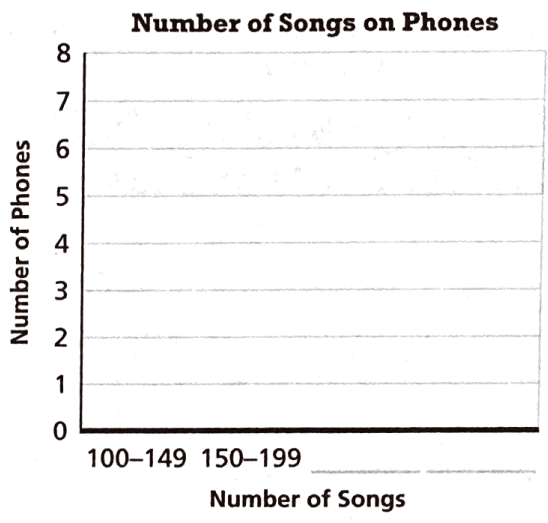
Number of Songs on Phones

125, 289, 115, 203, 192, 178, 256,
248, 165, 233, 147, 209, 225,
184, 156, 201, 143, 125, 263, 210

6. Complete the frequency table below for the number of songs stored on phones.

Song Range	Tally	Frequency
100–149	<input style="width: 40px; height: 30px;" type="text"/>	<input style="width: 40px; height: 30px;" type="text"/>
150–199	<input style="width: 40px; height: 30px;" type="text"/>	<input style="width: 40px; height: 30px;" type="text"/>
200– <input style="width: 30px; height: 20px;" type="text"/>	<input style="width: 40px; height: 30px;" type="text"/>	<input style="width: 40px; height: 30px;" type="text"/>
<input style="width: 30px; height: 20px;" type="text"/> – <input style="width: 30px; height: 20px;" type="text"/>	<input style="width: 40px; height: 30px;" type="text"/>	<input style="width: 40px; height: 30px;" type="text"/>

7. Use your frequency table to complete the histogram.



8. How many people have between 150 and 199 songs stored on their phones?

9. Do more than half of the phones have fewer than 149 songs stored on them?

10. Is the greatest number of songs stored on phones between 200 and 249 songs?

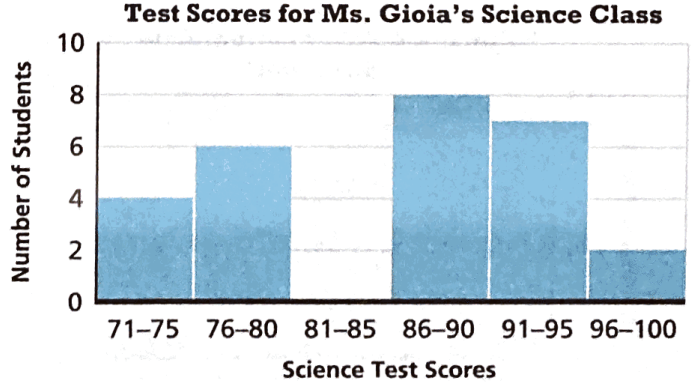
11. Are there more phones that have between 200 and 249 songs stored on them than have between 150 and 199 songs?

In 12–14, use the data in the histogram.

12. How many students in Ms. Gioia’s class took the science test?

13. How many more students had scores that were 80 or lower than had scores that were higher than 90?

14. **Be Precise** Can you tell from the histogram how many students scored 83 on the test? Explain. © MP.6



In 15–17, use the data in the chart.

Bicycle Stopping Times (in seconds)

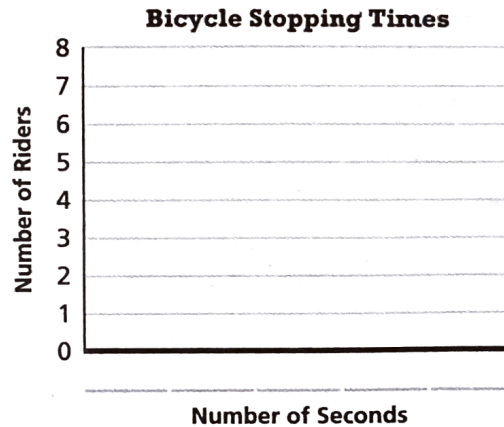
15, 25, 11, 8, 10, 21, 18, 23, 19, 9,
14, 16, 24, 18, 10, 16, 24, 18, 9, 14

15. Reasoning Todd wants to know how many people took 20 seconds or more to stop a bike safely. Would a frequency table or a histogram be the better way to show this? Explain. © MP.2

16. Higher Order Thinking When organizing the data, what interval should Todd use? Explain.

17. Model with Math Make a frequency table and histogram for the data. © MP.4

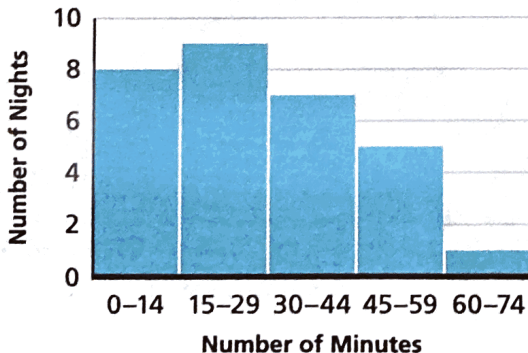
Time (in seconds)	Tally	Frequency



© Assessment Practice

18. Lissa recorded the time it took her to complete her homework each night for one month.

Time Lissa Takes to Complete Her Homework



According to the histogram, which statements accurately describe Lissa’s data? Select all that apply.

- Lissa worked on her homework for at least an hour one time.
- On more than half of the nights in the month, Lissa spent less than 30 minutes on her homework.
- The most time spent on homework each night was between 15 and 29 minutes.
- It took between 15 and 29 minutes more often than it took between 30 and 59 minutes.
- There were 31 days in that month.