Lesson Two Purpose

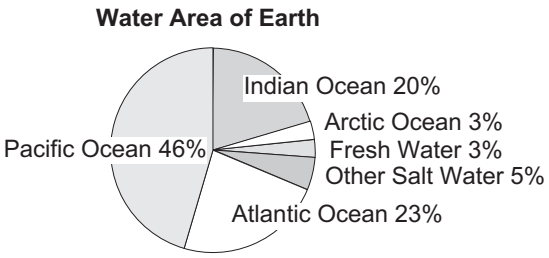
- Add, subtract, multiply, and divide real numbers, including square roots and exponents, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator. (MA.A.3.4.3)
- Use concrete and graphic models to derive formulas for finding rate, distance, time, and angle measures. (MA.B.1.4.2)
- Solve real-world problems involving rated measures (miles per hour, feet per second). (MA.B.2.4.2)
- Describe, analyze, and generalize relationships, patterns, and functions using words, symbols, variables, tables, and graphs. (MA.D.1.4.1)
- Interpret data that has been collected, organized, and displayed in charts, tables, and plots. (MA.E.1.4.1)

Using Other Data Displays—Circle Graphs and Bar Graphs

An important consideration when establishing a speed limit for a road is the speed at which most drivers travel under ideal driving conditions. Radar speed observations are made and a technical analysis is done to determine the 85th percentile, or the speed under which 85 percent of the drivers are traveling. Other considerations include factors such as volume of traffic and accident frequency.

While the *stem-and-leaf plot* of state speed limits used in Lesson One is helpful in some ways, it does not allow us to determine the speed limit for a specific state, such as Florida. It also does not allow us to compare the difference in speed limits for rural interstates and urban interstates for a particular state. We need a different type of data display for this purpose.

Circle Graphs

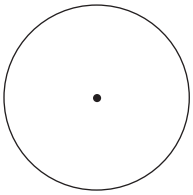


circle graph

Circle graphs are used to *compare parts of a whole*. *Circle graphs* display data expressed as fractional parts or **percents (%)** of a whole. The entire circle represents the whole, which is 100%. Each part is shown as a percent of the whole.

Recall that a circle contains 360 **degrees (°)**. When making a circle graph, we must determine what fractional part of the 360 degrees in the circle should be used for each **sector** (or part) of the circle representing a category of data.

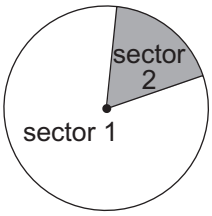
To Make a Circle Graph



center of a circle

- Draw a **circle** and mark the **center of the circle**.

  A circle has 360 degrees (°). The circle represents 100% of the data.

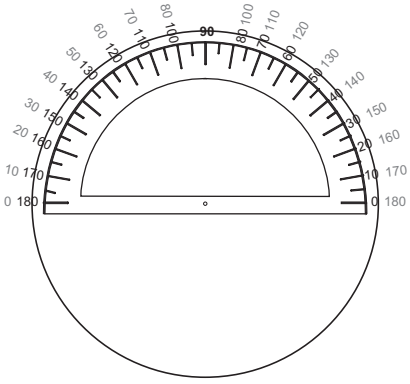


sectors of a circle or central angle

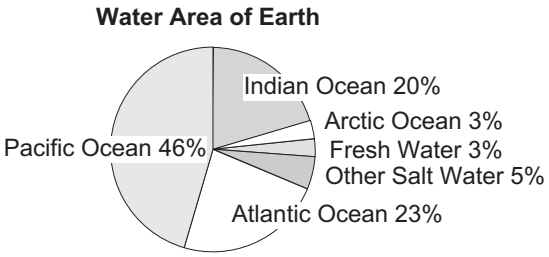
- Determine the degrees in a *sector* or part of the circle.

  Each *sector* of the circle represents a fractional part or a *percent of the data*. Some arithmetic will be necessary to find the percent and to represent that percent as a sector in the circle graph.

- Use a **protractor** to draw a **central angle** with the degree of measure assigned to the data.

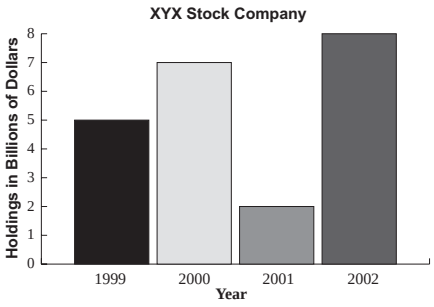


- Label and title your circle graph.

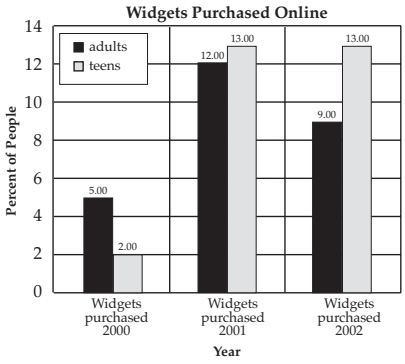


Bar Graphs

Bar graphs use lengths of bars to *compare quantities* of data about different things at a given time. **Double bar graphs** are used to compare quantities of *two sets of data*. Bar graphs have two **axes**: a *horizontal axis* (↔) and a *vertical axis* (↕). One of these axes is **labeled** with a numerical **scale**.

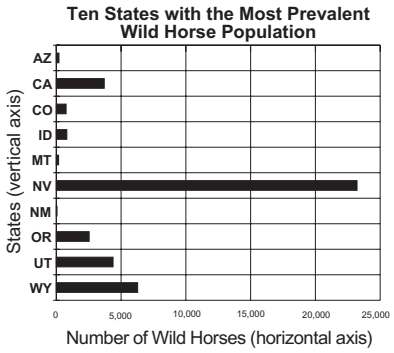


bar graph

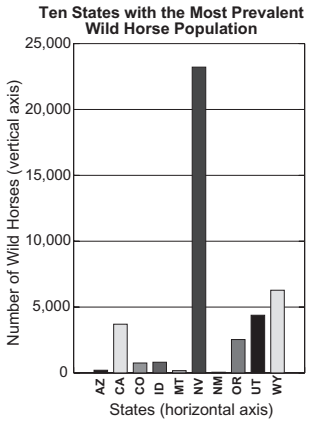


double bar graph

There are horizontal bar graphs and vertical bar graphs.



horizontal bar graph



vertical bar graph

To Make a Bar Graph

- Title the graph.
- Draw and label the horizontal axis (↔) and the vertical axis (↕).
- Mark off equal scales on one of the axes. Create and label appropriate scales to best represent the data.
- Draw and label bars with space between each one to show quantities.
- Include a *key* to show which bar represents which data for double bar graphs.

Practice

Use the chart below to complete the following.

Comparison of Speed Limits on Urban Interstates for States Having a Speed Limit of 70 Miles per Hour on Rural Interstates

State	Rural Interstates	Urban Interstates
Alabama	70	70
Arkansas	70	55
California	70	65
Florida	**70**	**65**
Georgia	70	65
Kansas	70	70
Louisiana	70	55
Michigan	70	65
Minnesota	70	65
Mississippi	70	70
Missouri	70	60
North Carolina	70	65
North Dakota	70	55
South Carolina	70	70
Tennessee	70	70
Texas	70	70
Washington	70	60
West Virginia	70	55

1. Of the states having a speed limit of 70 miles per hour (mph) on rural interstates, _____ have a speed limit on urban interstates greater than Florida's and _____ have a speed limit on urban interstates less than Florida's.

2. Of the states having a speed limit of 70 mph on rural interstates, _____ have the same limit on urban interstates and _____ have a reduced limit on urban interstates.

The following will help prepare you to represent this data in a circle graph.

3. _____ states out of 18 have a speed limit of 70 mph on urban interstates. Therefore, _____ degrees (°) out of 360 should be used for the sector representing these states.

   Remember: 360° = total number of degrees in a circle.

4. _____ states out of 18 have a speed limit of 65 mph on urban interstates. Therefore, _____ degrees out of 360 should be used for the sector representing these states.

Think: Here's one way to consider working number 4.

number of states with speed limit of 70 mph = 6
number of total states = 18

$$\frac{6}{18} = \frac{1}{3}$$

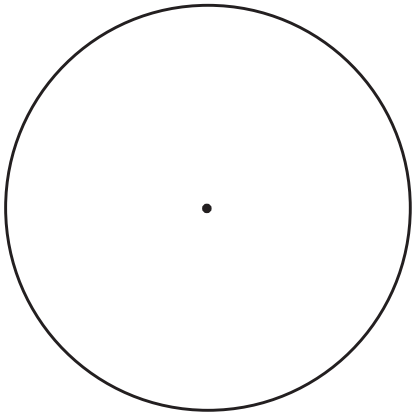
- multiply the fractional part by 360 degrees

$$\frac{1}{\cancel{3}_1} \times \frac{\cancel{360}^{120}}{1} = 120°$$

5. _____ states out of 18 have a speed limit of 60 mph on urban interstates. Therefore, _____ degrees out of 360 should be used for the sector representing these states.

6. _____ states out of 18 have a speed limit of 55 mph on urban interstates. Therefore, _____ degrees out of 360 should be used for the sector representing these states.

7. Use the circle graph below to represent your data from numbers 3-6 on the previous page. Title the graph and label each section.



8. The same data from numbers 3-6 on the previous page could be displayed in a bar graph. Make a bar graph for this data.

9. If you were reporting this data, would you prefer to use the table, circle graph, or bar graph in your report? Why?

_____

_____

_____

_____

Complete the following.

10. The speed limit in some states on rural interstates is 75 mph. These states are Arizona, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oklahoma, South Dakota, Utah, and Wyoming.

    What factor(s) do you think contribute to the higher speed limit for these states?

    _____

    _____

    _____

    Where might you seek information to verify your thinking?

    _____

    _____

11. Refer to the **road map** of the **United States** below.

- Major interstate highways running *north to south* have *odd* numbers. I-95 runs along the Atlantic Coast and is an important interstate in Florida.
- Major interstate highways running *east to west* are *evenly* numbered. I-10 runs near the Mexican border and is an important interstate in northern Florida.

a. What interstate runs *north to south* along the *Pacific coast*?

_____

b. What interstate runs *east to west* near the *Canadian border*?

_____

Road Map of the United States

Practice

Use the **distance formula** *below to solve the following.*

distance = rate x time
d = rt

1. The distance from Jacksonville to Pensacola along Interstate 10 is 364 miles. If this distance was covered in 6.5 hours without stopping, what was the average rate of speed?

   _____ miles per hour (mph)

2. The distance from Jacksonville to Pensacola along Interstate 10 is 364 miles. If the average speed for a driver is 70 mph, how long in hours and minutes will the trip require without stops?

   _____ hours _____ minutes

   How many minutes does 0.2 of an hour equal?

   Here's one way to consider working the problem.

   Hint: Convert 0.2 to a **fraction**.

   $0.2 = \frac{2}{10}$

   Now multiply $\frac{2}{10}$ times 1 hour, which equals 60 minutes.

   $\frac{2}{\cancel{10}_1} \bullet \frac{\cancel{60}^6}{1} = 12$ minutes

3. For a driver traveling west on Interstate 80 from Salt Lake City to Wendover on the Nevada border, a map shows the distance to be 125 miles and the estimated driving time to be 2 hours and 27 minutes. If the rural interstate speed limit of 75 mph is maintained on this road for the distance of 125 miles, how much less will the actual driving time be than the estimated driving time?

_____ minutes

Here's one way to consider working the problem.

Hint: How many minutes does 0.67 of an hour equal? Convert 0.67 to a *fraction*.

$0.67 \approx \frac{2}{3}$ ($\frac{67}{100}$ is about $\frac{2}{3}$)

$\frac{2}{\cancel{3}_1} \times \frac{\cancel{60}^{20}}{1} = 40$

Remember: ≈ means approximately

4. When driving west on Interstate 80, a driver will cross the Nevada border at West Wendover. After one segment runs slightly northwest and a later segment runs southwest, Reno is reached. The distance is 402 miles. If the speed limit of 75 mph is maintained, will the trip require more or less than 5 hours 30 minutes without stops?

_____

Explain your answer. _____

_____

_____

_____

5. When driving west on Interstate 64 from Lexington to Louisville, a driver will travel 79 miles. If Kentucky's rural interstate speed limit of 65 mph is maintained, will the trip require more or less than 1 hour and 15 minutes?

   _____

   How did you get your answer? _____

   _____

   _____

   _____

6. In Hawaii, the speed limit on rural interstates is 60 miles per hour. If this rate is maintained for 10 minutes, what distance is traveled?

   _____ miles

   Here's one way to consider working the problem.

   Hint: Before using the distance formula, convert minutes into a fraction of an hour.

   10 minutes = $\frac{10}{60} = \frac{1}{6}$

7. In the District of Columbia, the location of our nation's capital city, all interstate roadway is considered urban interstate and the speed limit is 55 mph. If that speed is maintained for 30 minutes, what distance is traveled?

_____ miles

8. Drivers of two vehicles approach a section of urban interstate in Florida. Each sees a sign indicating that the speed limit is reduced from 70 mph to 65 mph.

   - Driver A chooses to reduce speed accordingly and reaches the sign, allowing speed to be again increased to 70 mph 12 minutes later.
   - Driver B continues to drive at a rate of 70 mph, ignoring the lawful speed limit.

   How much farther does Driver B go in 12 minutes than Driver A?

   _____

Practice

Use the list below to write the correct term for each definition on the line provided.

axes (of a graph)	**circle graph**	**percent (%)**
bar graph	**degree (°)**	**scale**
center of a circle	**labels (for a graph)**	**sector**
central angle (of a circle)		

_____ 1. a special-case ratio which compares numbers to 100 (the second term)

_____ 2. a data display that divides a circle into regions representing a portion of the total set of data

_____ 3. a part of a circle bounded by two radii and the arc or curve created between any two of its points

_____ 4. a graph that uses either vertical or horizontal bars to display data

_____ 5. the point from which all points on the circle are the same distance

_____ 6. the numeric values, set at fixed intervals, assigned to the axes of a graph

_____ 7. common unit used in measuring angles

_____ 8. the titles given to a graph, the axes of a graph, or the scales on the axes of a graph

_____ 9. the horizontal and vertical number lines used in a coordinate plane system

_____ 10. an angle that has its vertex at the center of a circle, with radii as its sides