Graphing Skills

Line Graphs

In laboratory experiments, you will usually be controlling one variable and seeing how it affects another variable. Line graphs can show these relations clearly. For example, you might perform an experiment in which you measure the growth of a plant over time to determine the rate of the plant's growth. In this experiment, you are controlling the time intervals at which the plant height is measured. Therefore, time is called the *independent variable*. The height of the plant is the *dependent variable*. ***Table 1*** gives some sample data for an experiment to measure the rate of plant growth.

The independent variable is plotted on the *x*-axis. This axis will be labeled *Time (days)*, and will have a range from 0 days to 35 days. Be sure to properly label your axis including the units on the values.

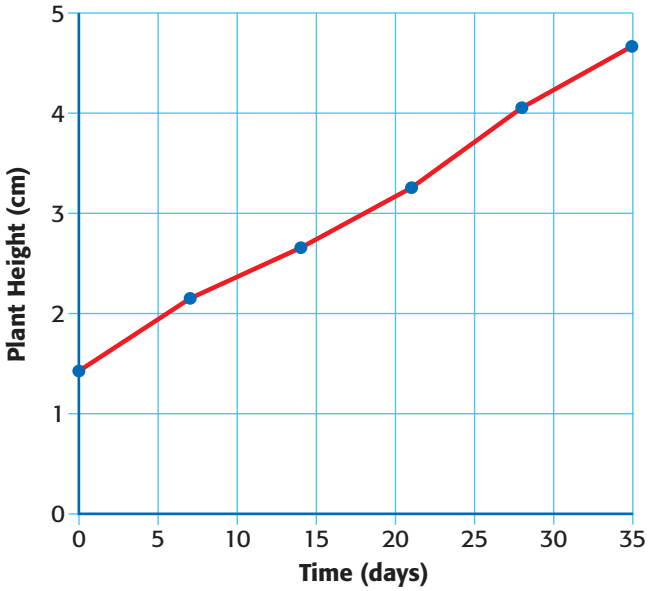
The dependent variable is plotted on the *y*-axis. This axis will be labeled *Plant Height (cm)* and will have a range from 0 cm to 5 cm.

Think of your graph as a grid with lines running horizontally from the *y*-axis, and vertically from the *x*-axis. To plot a point, find the *x* (in this example time) value on the *x* axis. Follow the vertical line from the *x* axis until it intersects the horizontal line from the *y*-axis at the corresponding *y* (in this case height) value. At the intersection of these two lines, place your point. ***Figure 1*** shows what a line graph of the data in ***Table 1*** might look like.

Table 1 **Experimental Data for Plant Growth versus Time**

Time (days)	Plant height (cm)
0	1.43
7	2.16
14	2.67
21	3.25
28	4.04
35	4.67

Figure 1



Practice

1. What does the line in ***Figure 1*** show, and what can you conclude about the plants used in the experiment?
2. Create a line graph of the following data.

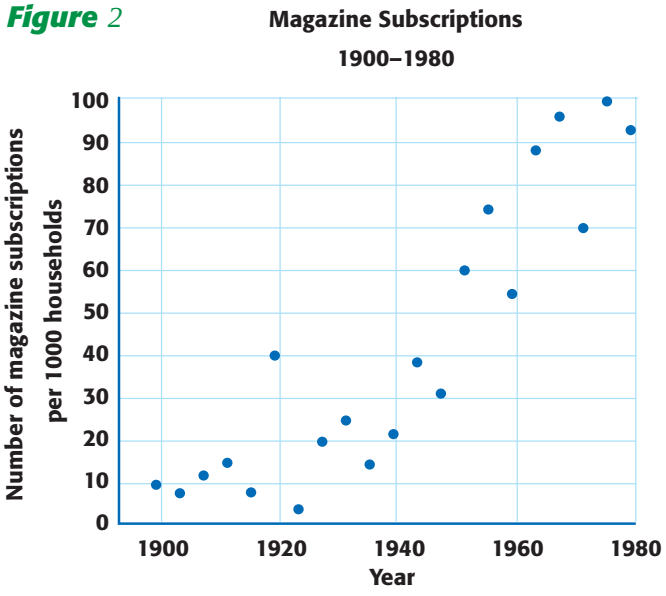
Number of Days	Plant height (cm)
0	1.46
7	2.67
14	3.89
21	4.82

3. Compare the graph you made with ***Figure 1***. What can you conclude about the two different groups of plants?

Scatter Plots

Some experiments or groups of data are best represented in a graph that is similar to a line graph and that is called a scatter plot. As in a line graph, the data points are plotted on the graph by using values on an x-axis and a y-axis. Scatter plots are often used to find trends in data. Instead of connecting the data points with a line, a trend can be represented by a best-fit line. A best-fit line is a line that represents all of the data points without necessarily going through all of them. To find a best-fit line, pick a line that is equidistant from as many data points as possible. Examine the graph below.

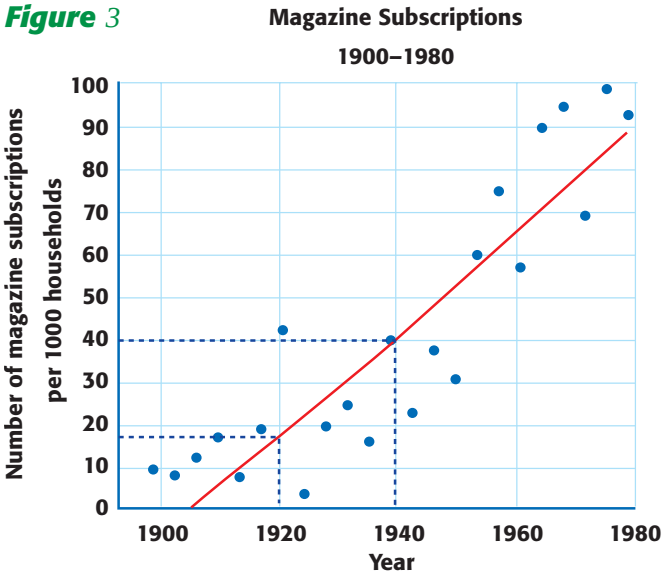
***Figure** 2*



If we connected all of the data points with lines, the lines would create a zigzag pattern that would not tell us much about our data. But if we find a best-fit line, we can see a trend more clearly. Furthermore, if we pick two points on the best-fit line, we can estimate its slope. Examine the dotted lines on ***Figure** 3*.

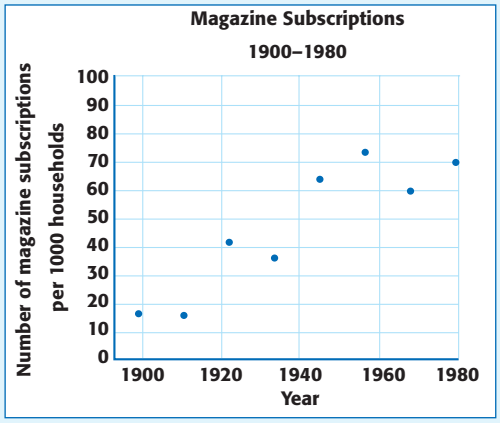
The points can be estimated as 18 magazine subscriptions per 100 households in 1920, and 42 magazine subscriptions per 100 households in 1940. If we subtract 1920 from 1940, and 18 subscriptions from 42 subscriptions (using the point slope formula), we see that the line shows a trend of an increase of 24 subscriptions per 1000 households acres every 20 years. Scatter plots can also be used when there are two or more trends within one group of data or when there is no distinct trend at all.

***Figure** 3*



Practice

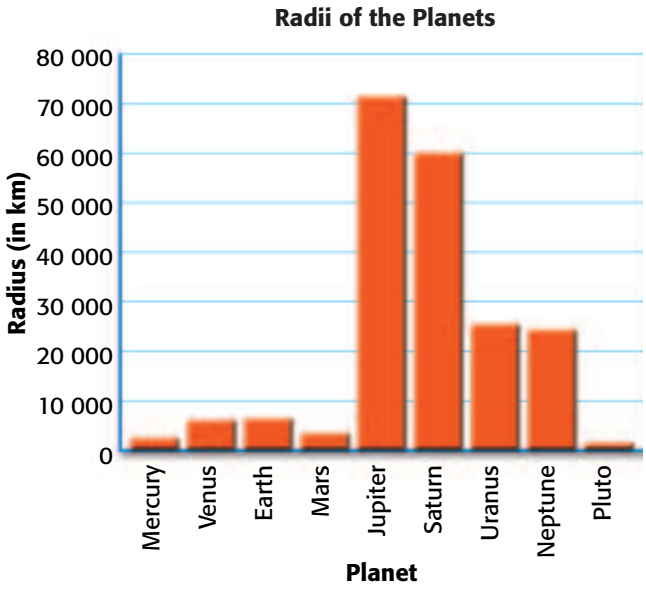
1. Copy the graph below, and draw a best-fit line.



2. What does that line represent?
3. If these were the data from a different city than the data in ***Figure** 3*, what conclusions could you draw about the two cities?

Bar Graphs

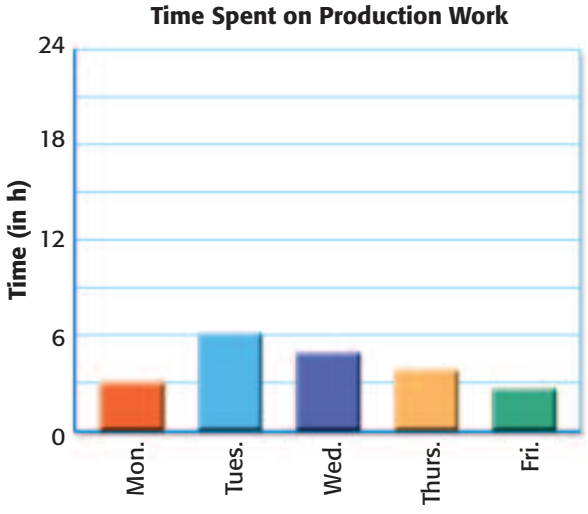
***Figure** 4*



Bar graphs make it easy to compare data quickly. We can see from ***Figure** 4* that Jupiter has the largest radius, and that Pluto has the smallest radius. We can also quickly arrange the planets in order of size.

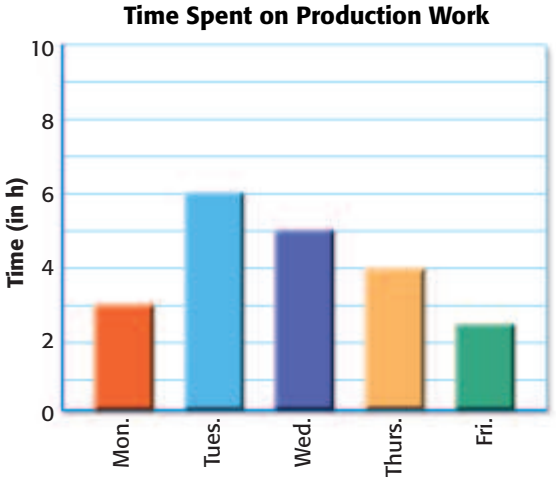
Bar graphs can also be used to identify trends, especially trends among differing quantities. Examine ***Figure** 5* below.

***Figure** 5*



The data are represented accurately, but it is not easy to draw conclusions quickly. Remember that when you are creating a graph, you want the graph to be as clear as possible. If we graph the exact same data on a graph with slightly different axes, as shown in ***Figure** 6*, it may be much easier to draw conclusions.

***Figure** 6*



Practice

1. What day of the week is most productive, according to ***Figure** 6*?
2. What day of the week is least productive?
3. Using the following data, create a clear and easily readable bar graph.

Fiscal period	Money spent (in millions)
First quarter	89
Second quarter	56
Third quarter	72
Fourth quarter	41

Pie Charts

Pie charts are an easy way to visualize how parts make up a whole. Frequently, pie charts are made from percentage data such as the data in ***Table*** *2*.

Table *2* **Elemental Composition of Earth's Crust**

Element	Percentage of Earth's Crust
Oxygen	46%
Silicon	28%
Aluminum	8%
Iron	6%
Calcium	4%
Sodium	2%
Magnesium	2%
Potassium	2%
Titanium	1%
All remaining elements	1%

To create a pie chart, begin by drawing a circle. Imagine dividing the circle into 100 equal parts. Because 50 parts would be half of the circle, we know that 46% will be slightly less than half of the pie. We shade a piece that is less than half, and label it "Oxygen." Continue this process until the entire pie graph has been filled. Each element should be a different color to make the chart easy to read as in ***Figure*** *7*.

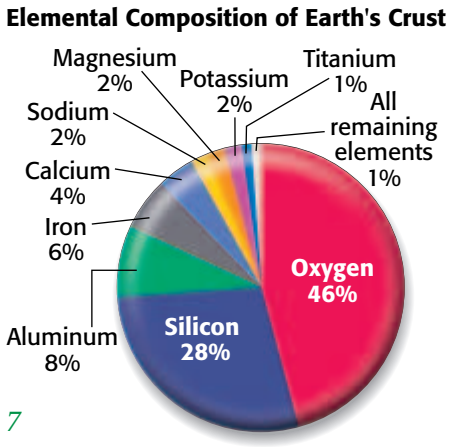
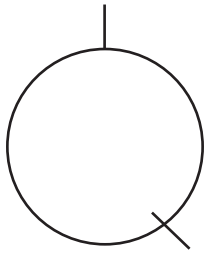


Figure *7*

Another way to construct a pie chart involves using a protractor. This method is especially helpful when your data can't be converted into simple fractions. First, convert the percentages to degrees by dividing each number by 100 and multiplying that result by 360. Next, draw a circle and make a vertical mark across the top of the circle. Using a protractor, measure the largest angle from your table and mark this angle along the circumference. For example, 32.9% would be 118° because 32.9/100 = .329 and .329 × 360 = 118.



Next, measure a second angle from the second mark to make a third mark along the circumference. Continue this process until all of your slices are measured. Draw lines from the marks to the center of the circle, and label each slice.

Practice

1. Use the data below to create a pie chart.

Kind of land use	Percentage of total land
Grassland and rangeland	29
Wilderness and parks	9
Urban	2
Wetlands and deserts	3
Forest	30
Cropland	17

2. If humans use half of forests and grasslands, plus all of croplands and urban areas, how much of the total land is used by humans?