Lesson: Displaying data and recognizing trends.

Eighth Grade Objective: 4.01 Collect, organize, analyze, and display data (including scatterplots) to solve problems.

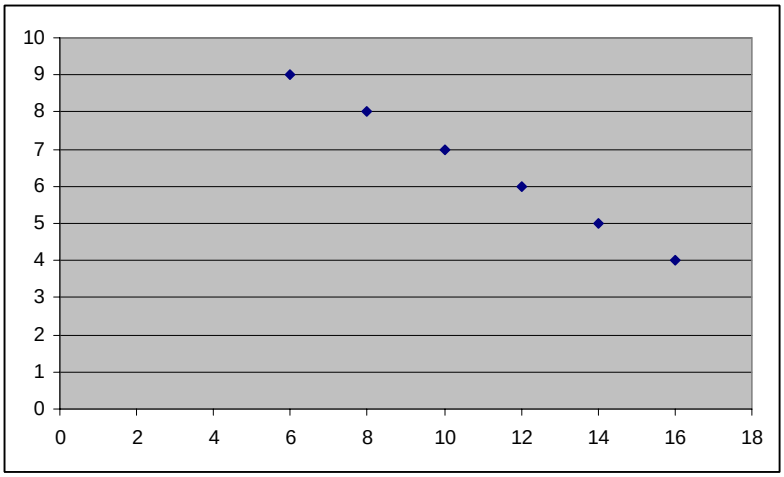
Lesson:

Scatterplots can give us insight into patterns in data. By analyzing a scatterplot, we can make predictions for values that are not given to us.

Of course, when creating scatterplots, we need to be sure to first to determine which variable is our independent variable and which is our dependent variable. Once we have determined that, we need to devise an appropriate scale and interval. Remember, scales and intervals can vary. It is important for the scale to begin with a number less than or equal to the smallest number in the data set, and end with a number that is greater than or equal to the largest number in the data set. The interval should be reasonable and consistent. If you choose to count by 2's, consistently count by 2's. It is not necessary to count by the same number on each axis, although it does make finding the rate of change easier.

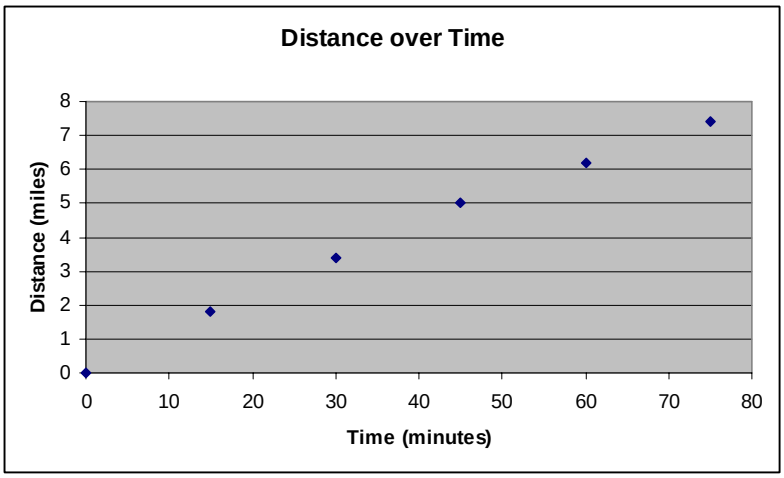
Sketch scatterplots for each of the following sets of data:

x	y
6	9
8	8
10	7
12	6
14	5
16	4



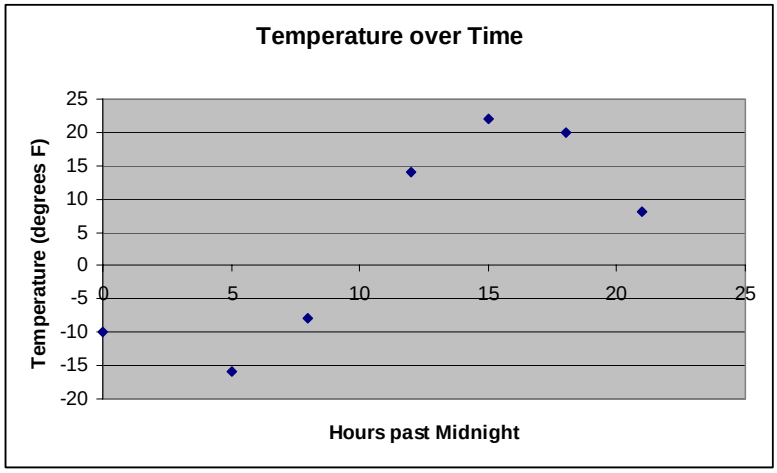
The scale on the x-axis must start at 6 or less and end at 16 or greater. Because of the spread of the data, I will count by 2's on the x-axis. The scale on the y-axis must start at 4 or less and end at 9 or greater. Because of the spread of the data, I will count by 1's on the y-axis.

Time (minutes)	Distance (miles)
0	0
15	1.8
30	3.4
45	5.0
60	6.2
75	7.4



The scale on the x-axis must start at zero or less and must end at 75 or greater. I have chosen to count by 10, since the spread of the data is fairly large. The scale on the y-axis must start at or below 0 and must end at 7.4 or above. I will count by one's since the spread of data is fairly small.

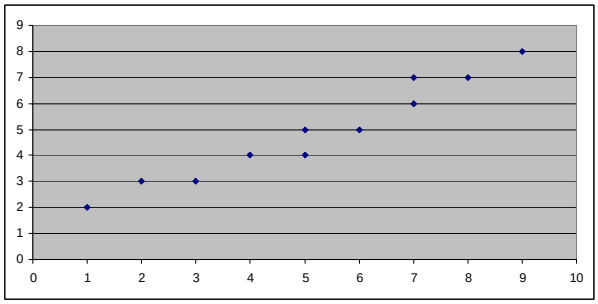
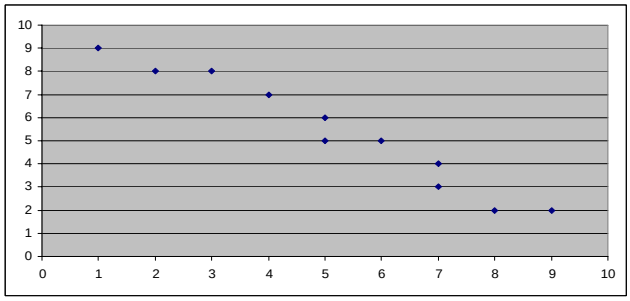
Temperature (degrees F)	Time since midnight (hours)
-10	0
-16	5
-8	8
14	12
22	15
20	18
8	21



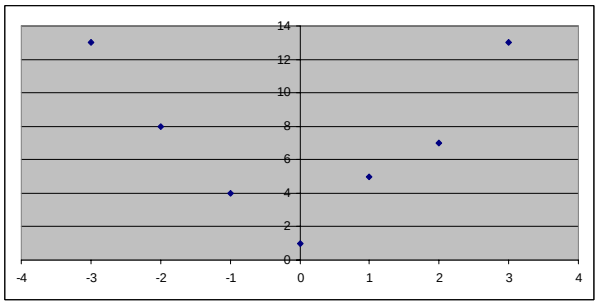
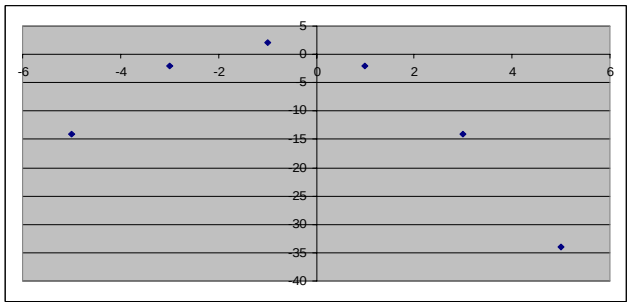
First, notice that the data is not written with the x variable in the left column. Time is the independent variable and temperature is the dependent variable, therefore time is graphed on the x-axis and temperature is graphed on the y-axis. The scale on the x-axis must begin at or below 0 and must end at or above 21. Because of the relatively large spread of the data, I will choose to count by 5's. Notice that each individual data piece does not have to be directly over or under a labeled number, it is ok to have data values in between labeled numbers. The scale on the y-axis must start at or below -16 and must end at or above 22. I will county by 5's, again, because of the relatively large spread of data.

It is possible to use scatterplots to make predictions. Before we can make a prediction from a scatterplot, we must first recognize the types of trends commonly seen in data.

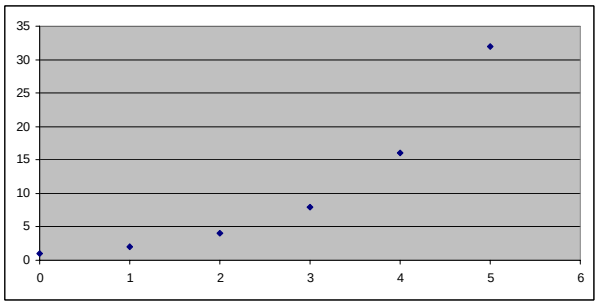
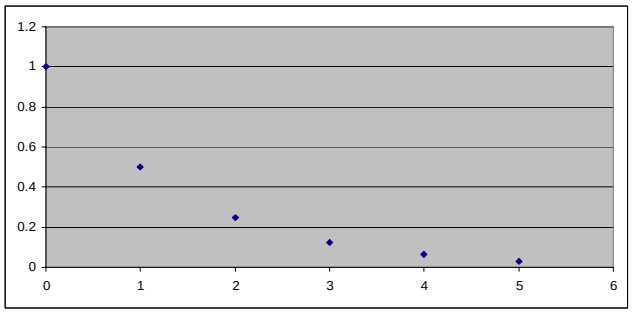
Linear trends are those whose points generally follow the trend of a line. The line can have a positive (upward) trend, or a negative (downward) trend.

Quadratic trends are those whose points generally follow the trend of a quadratic graph. Quadratic graphs are in the shape of a parabola, or a U-shape.

Exponential graphs are those whose points generally follow the trend of an exponential graph. Exponential graphs can start out increasing slowly and then begin to increase rapidly (exponential growth) or they can decline rapidly and then begin to decline more slowly (exponential decay).

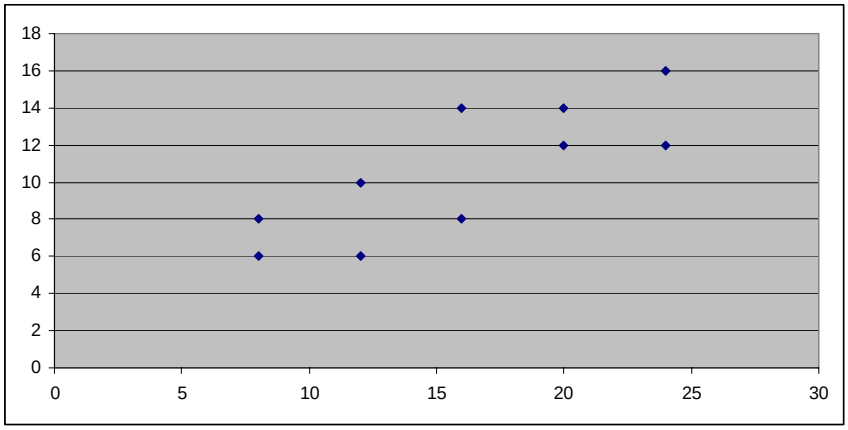
Once you have determined the general trend of a set of data, it is possible to use that set of data to make predictions for data points that are not given.

Graph a scatterplot of the data values given. Tell what type of relationship the data points seem to have and make a prediction for the value given.

x	y
8	8
8	6
12	6
12	10
16	8
16	14
20	14
20	12
24	16
24	12

Predict the value of y when x is 30.

Predict the value of x when y is 30.

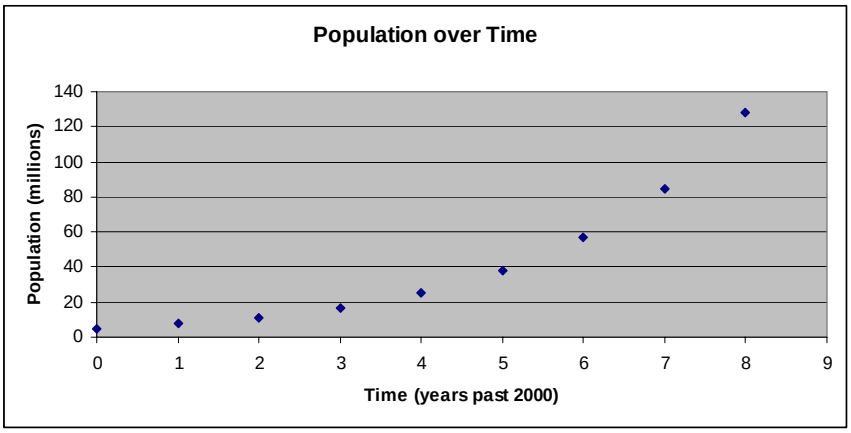


The graph appears to have a positive linear relationship. An approximate value of y when x is 30: 17. An approximate value of x when y is 30: 50.

Years past 2000	Population (millions)
0	5
1	8
2	11
3	16
4	25
5	38
6	57
7	85
8	128

Predict the year in which the population will exceed 300 million.

Prediction the population in the year 1999.



The data appears to show exponential growth. The population will exceed 300 million after 2010. The population in the year 1999 was about 4 million.

Try these on your own!
For each problem:

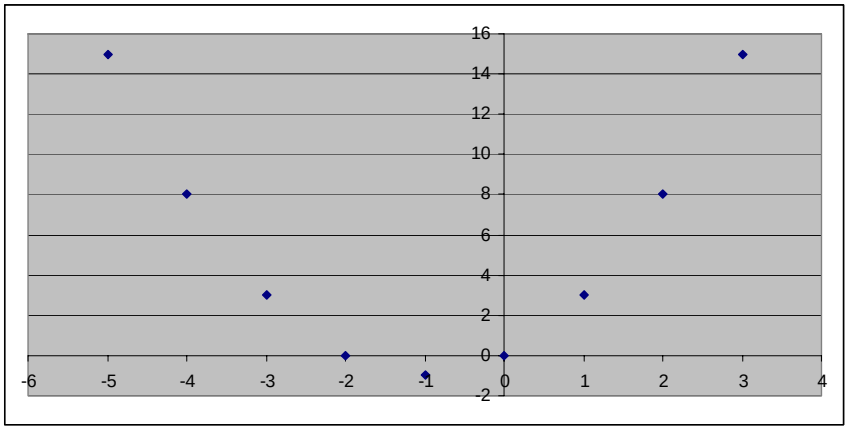
1. Draw a scatterplot with appropriate scales and intervals.
2. Determine what type of relationship the data points seem to have.
3. Make the predictions indicated.

1.

x	y
-5	15
-4	8
-3	3
-2	0
-1	-1
0	0
1	3
2	8
3	15

Predict the value for x when y is 25.

Predict the value for y when x is 5.



The relationship appears quadratic. The value for x when y is 25 could be estimated at 4. The value for y when x is 35. If your solutions are close to those two numbers, consider yourself correct, since these are estimates.

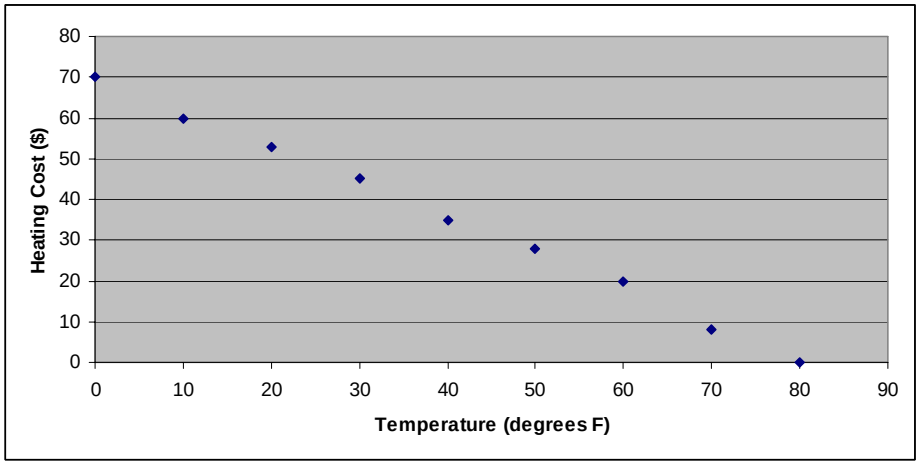
2.

Temperature (degrees F)	Heating Costs
0	70
10	60
20	53
30	45
40	35
50	28
60	20
70	8
80	0

Predict the heating cost when it is -10 degrees.

Predict the temperature when the heating costs are $40.

Heating Cost v Temperature



The variables seem to have a negative linear relationship. The heating costs when the temperature is -10 can be estimated at $80. The temperature when the heating costs are $40 can be estimated at 35 degrees F. Again, these are estimates. If you are close to those two predictions, you are most likely fine.

Quiz yourself!
Draw a scatterplot of the data presented using appropriate scales, intervals, and titles. Describe the relationship of the data and make the appropriate predictions.

1.

Time (days)	Amount of radioactive element remaining (grams)
1	100
3	50
5	25
7	13
9	6
11	3

Predict the amount of the radioactive element that existed at time zero.

Predict the time it will take for there to be less than 1 gram of the radioactive element remaining.

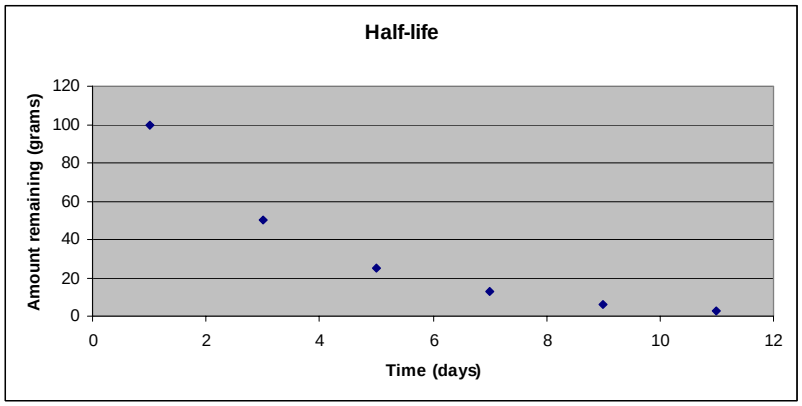
2.

Side length of a rectangle with perimeter 24 (inches)	Area of the rectangle (square inches)
1	11
2	20
3	27
4	32
5	35
6	36
7	35
8	32
9	27
10	20
11	11

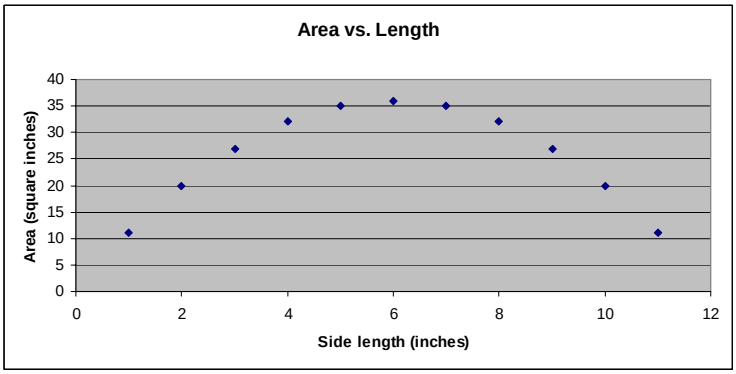
Predict the area of the rectangle if the side length is 4.5 inches.

Predict the side length of the rectangle if the area is 30 square inches.

Check your answers:
1.



This is exponential decay. The amount of radioactive element that was most likely in existence at time 0 is about 150 grams. The amount of time it will take the amount of radioactive element to be below 1 gram is about 15 days.
2.



This is a quadratic relationship. The area when the side length is 4.5 inches is approximately 34 square inches. The length when the area is 30 square inches is either about 3.5 inches or about 8.5 inches (notice the symmetry in the graph).