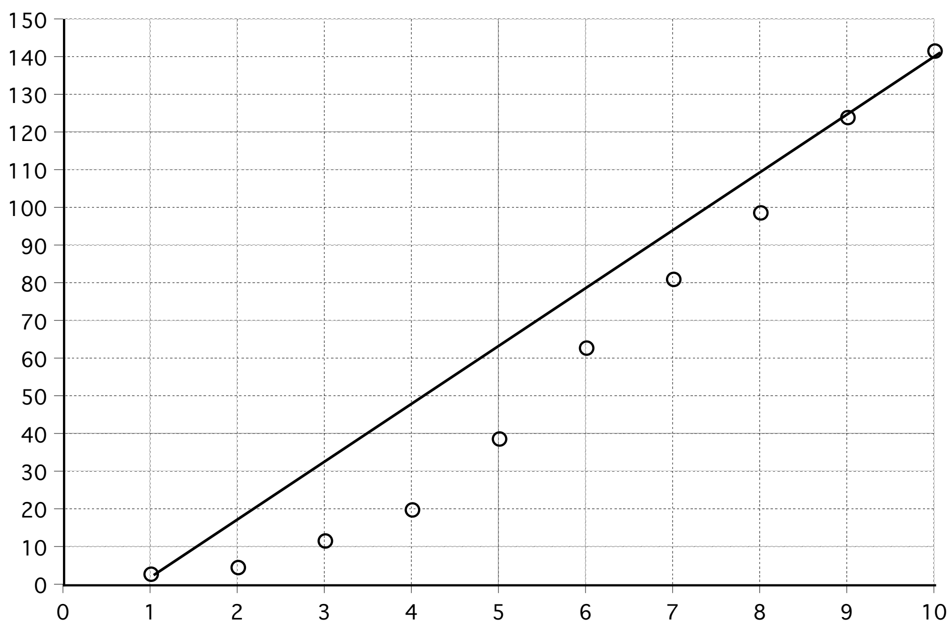
GRAPHS IN SCIENCE

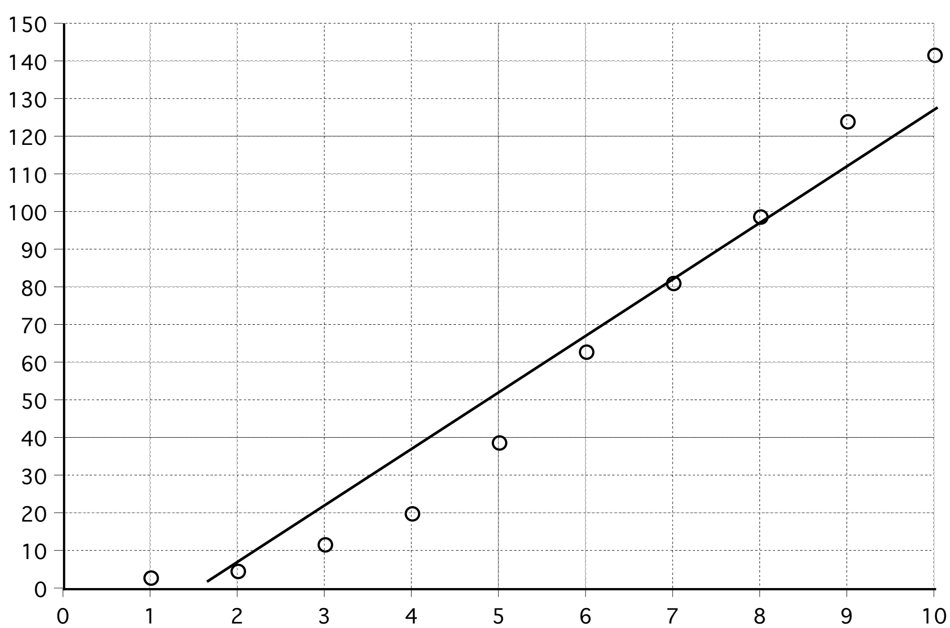
One of the things most often seen in a description of a science experiment is a graph of some kind. A graph is a visual representation of numerical data collected from an experiment. Some of the types of graphs you'll find in science are bar and pie graphs. The one used most often is a line graph, and it is this type of graph we will create and analyze most during a physical science class.

Most scientific graphs are made as a line graph. The resulting lines are usually drawn as a straight or a curved line. These "smoothed" lines do not have to touch all of the data points, but they should at least get close to most of them. These types of lines are called best-fit lines. **Best-fit lines** are usually drawn for data that is not continuously collected. For example, if you want to see how far you'll roll on roller-blades from different locations on a hill.

In the two Best-Fit lines at left, one is drawn correctly, the other is not. Which one is which?



Best Fit Line #1



Best Fit Line #2

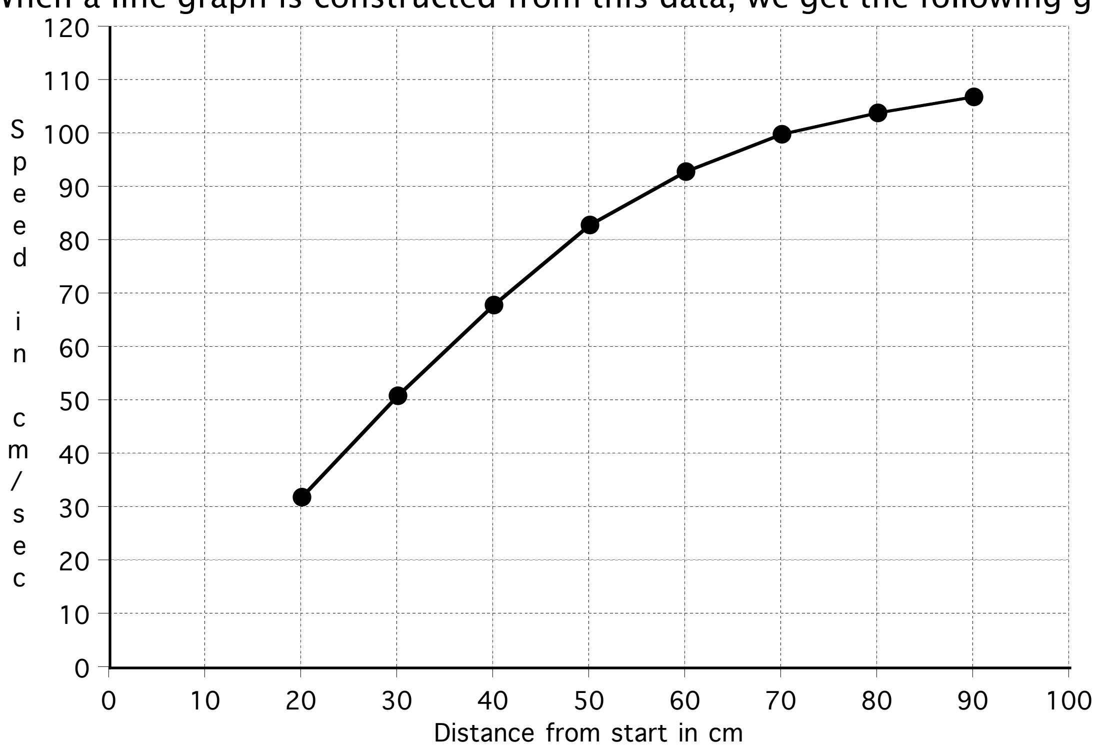
Occasionally, you will construct a line that is drawn in a connect-the-dot fashion. **Connect-the-dot lines** are constructed for data that is continuous. For example, a thermometer is used to record the changes in outside temperatures over the course of a day.

For a graph to be useful, the data collected must be as accurate and precise as possible, and it must be plotted accurately as well. A well constructed graph allows you to make reliable predictions in two basic ways. You can extend the line so it goes beyond the range of the data you collected. This is called **extrapolation**. It can also be used to estimate data between the data points that were plotted on the graph. This is called **interpolation**.

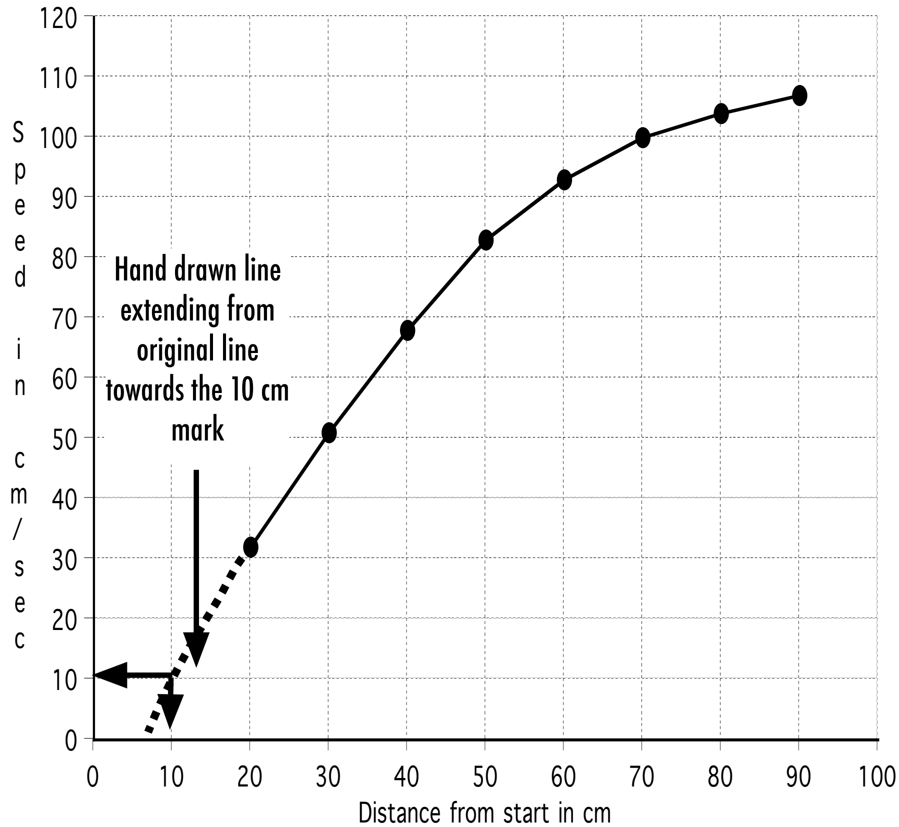
Consider the following data from an experiment similar to the one recently completed in class, that has a car rolling down a hill.

Distance from start in cm	Speed in cm/second
20	32
30	51
40	68
50	83
60	93
70	100
80	104
90	107

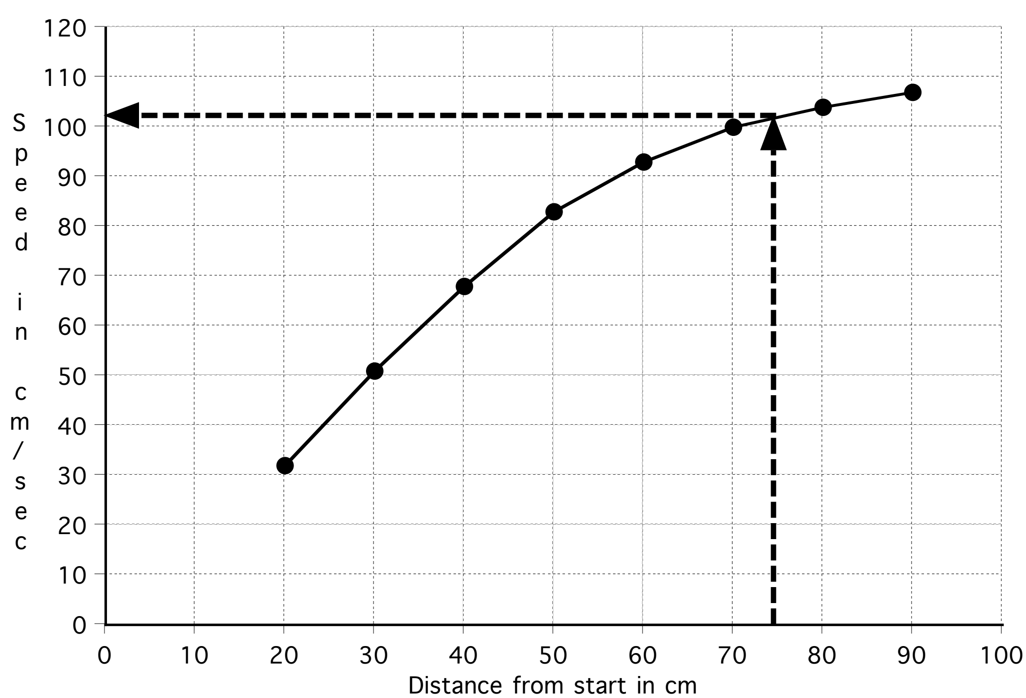
When a line graph is constructed from this data, we get the following graph.



To use this graph to predict what the speed of the car would be when it is 10 cm from the start, simply extend the line already there, so it slopes down to the left.



This **extending** of a graphed line is called **extrapolation.** Draw a vertical line up from the 10 cm mark on the x-axis so it intersects the extended line. Then draw a horizontal line from this point over to the left until it meets the y-axis. Our answer for the speed of the car at 10 cm from the start, is 10 cm/second.

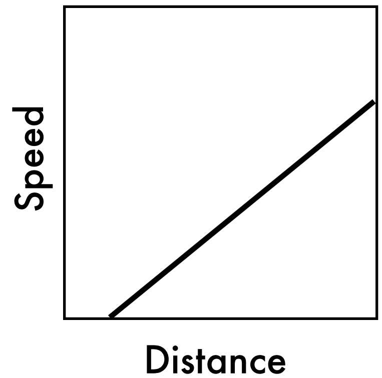


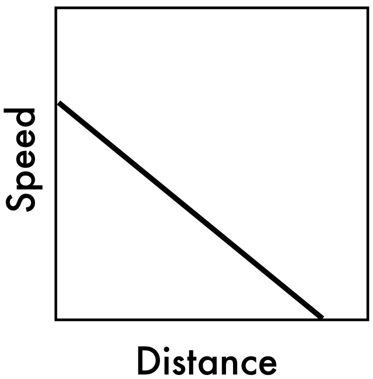
To determine the car's speed when it is 75 cm from the start, requires you to make an estimate **between** data points on the graph. This is called **interpolation**. Draw a vertical line up from the 75 cm mark on the x-axis so it intersects the line. Then draw a horizontal line from this point over to the left until it meets the y-axis. Our answer for the speed of the car at 75 cm from the start, is about 102 cm/second.

The data representing the independent variable is plotted along the x-axis, while the data representing the dependent variable is plotted along the y-axis.

When the axis' are labeled, **you do not have to start at zero**. **You do have to** have the numbers for the axis' **increasing** as you go towards the right along the x-axis,and as you go up along the y-axis.

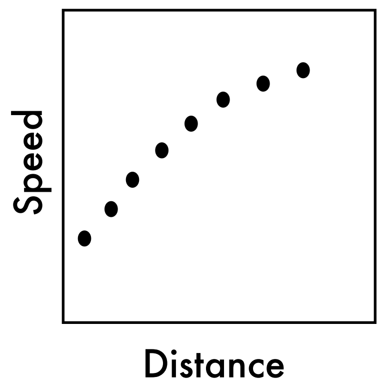
When a **direct relationship** exists between the independent and dependent variables, the line on the graph will always slope upwards to the right, as seen at right.

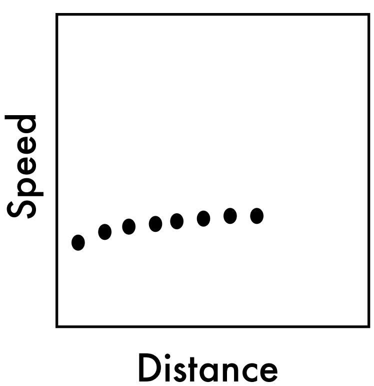




When an **indirect (inverse) relationship** exists between the independent and dependent variables, the line on the graph will always slope downwards to the right, as seen at left.

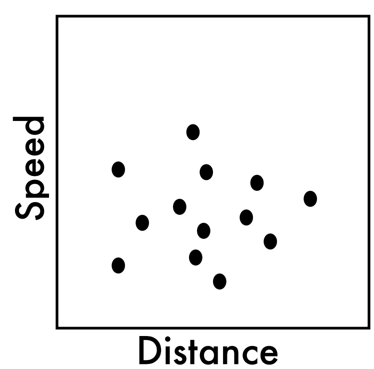
If there is a **strong relationship** between the independent and the dependent variables, then a small change in the independent variable produces a **large** change in the dependent variable. This produces a line that is steeply sloped, as seen at right.





If there is a **weak relationship** between the independent and the dependent variables, then a small change in the independent variable produces a **small** change in the dependent variable. This produces a line that is barely sloped as seen at left.

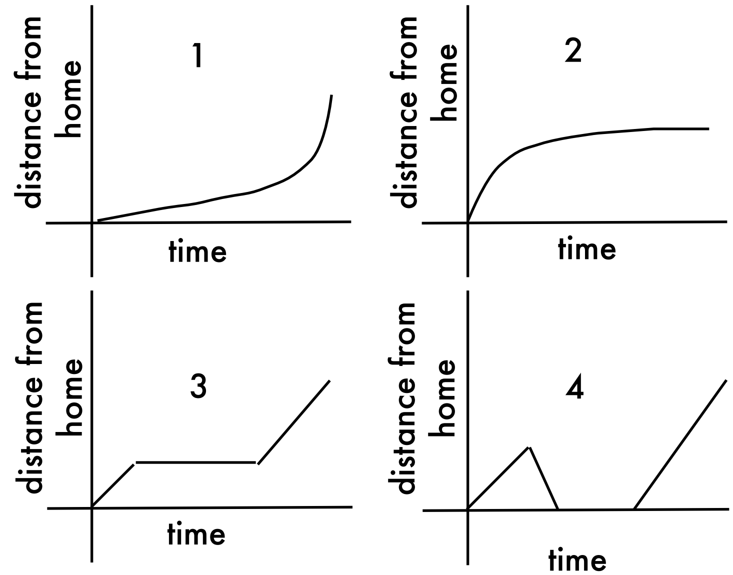
If no relationship exists between the independent and the dependent variables, then no observable pattern is formed as shown at right.



In addition to drawing graphs, it is also important that you be able to interpret data that is represented in graph form. The following examples are provided to help you develop the ability to read information shown on a graph.

1. Identify the graph that matches each of the following stories:

a. I had just left home when I realized I had forgotten my books so I went back to pick them up.
b. The battery on my electric car started to run down.
c. Things went fine until I had a flat tire.
d. I started out calmly, but sped up when I realized I was going to be late.



2. Which of the following hypotheses are best represented by this graph?

a. Smoking causes cancer.
b. Cancer is dangerous.
c. One out of a thousand people will get cancer during their lifetime.
d. Young people don't get cancer.
e. The probability of getting cancer increases with age.