Graphing

Graphs are a useful tool in science. The visual characteristics of a graph make trends in data easy to see. One of the most valuable uses for graphs is to "predict" data that is not measured on the graph.

1. Extrapolate: extending the graph, along the same slope, above or below measured data.
2. Interpolate: predicting data between two measured points on the graph.

Step	What To Do	How To Do It
		How To Construct a Line Graph On Paper

1	Identify the variables	a. Independent Variable - (controlled by the experimentor)
		   Goes on the X axis (horizontal)
		   Should be on the left side of a data table.
		b. Dependent Variable - (changes with the independent variable)
		   Goes on the Y axis (vertical)
		   Should be on the right side of a data table.

2	Determine the variable range.	a. Subtract the lowest data value from the highest data value. Do each variable separately.
3	Determine the scale of the graph.	a. Determine a scale, (the numerical value for each square), that best fits the range of each variable. Spread the graph to use MOST of the available space.
4	Number and label each axis.	a. This tells what data the lines on your graph represent.
5	Plot the data points.	a. Plot each data value on the graph with a dot. You can put the data number by the dot, if it does not clutter your graph.
6	Draw the graph.	a. Draw a curve or a line that best fits the data points. Most graphs of experimental data are not drawn as "connect-the-dots".
7	Title the graph.	a. Your title should clearly tell what the graph is about. b. If your graph has more than one set of data, provide a "key" to identify the different lines.

Graphing Practice Problem #1

pH of water	Number of tadpoles
8.0	45
7.5	69
7.0	78
6.5	88
6.0	43
5.5	23

Make a line graph of the data above.

A. **What is the dependent variable?**

B. **What is the independent variable?**

C. **What is the average pH in this experiment?**

D. **What is the average number of tadpoles per sample?**

E. **What is the optimum water pH for tadpole development?**

F. **Between what two pH readings is there the greatest change in tadpole number?**

G. **How many tadpoles would we expect to find in water with a pH reading of 5.0?**

Graphing Practice Problem #2

The energy needed to remove the most loosely held electron in an atom is called the First Ionization Energy. This energy for the first 18 elements is shown in the table below.

Atomic Number	1st I.E. (volts)
1	13.53
2	24.46
3	5.64
4	9.28
5	8.26
6	11.22
7	14.48
8	13.55
9	17.34
10	21.47
11	5.12
12	7.61
13	5.96
14	8.12
15	10.9
16	10.3
17	12.95
18	15.68

A. This data is very accurately measured. Plot the data points and then draw a line graph in "connect-the-dot" fashion.

Graphing Practice Problem #3

According to Charles' Law, the volume of a gas decreases as the temperature of the gas decreases. A sample of gas was collected at 100 degrees Celsius and then cooled. The changes in the volume of the sample are shown below.

Temperature (^{o}C)	Volume (ml)
100	317
80	297
60	288
40	278
30	252
20	243
10	236
0	233
-10	227
-30	202

A. Graph the data above.

B. Use one full sheet of graph paper to construct another graph that will allow you to extrapolate *(extend the graph beyond measured data)* the graph you made in part *A* to reach a gas volume of zero milliliters.

The temperature at which the volume of the gas reaches zero is the theoretical temperature of Absolute Zero. From your graph, what is the Celsius Temperature for Absolute Zero?