

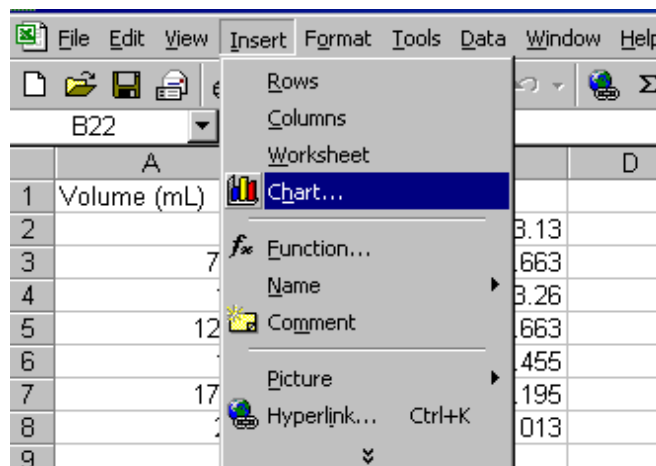
Introduction to Excel

We are going to use data to create a graph in Excel. It is often difficult to observe patterns in data if it is presented in data lists. When data is plotted on a graph, patterns are usually obvious. In observing a graph, we are looking for a linear pattern. If the pattern is not linear, we will transform the data in order to obtain a linear pattern.

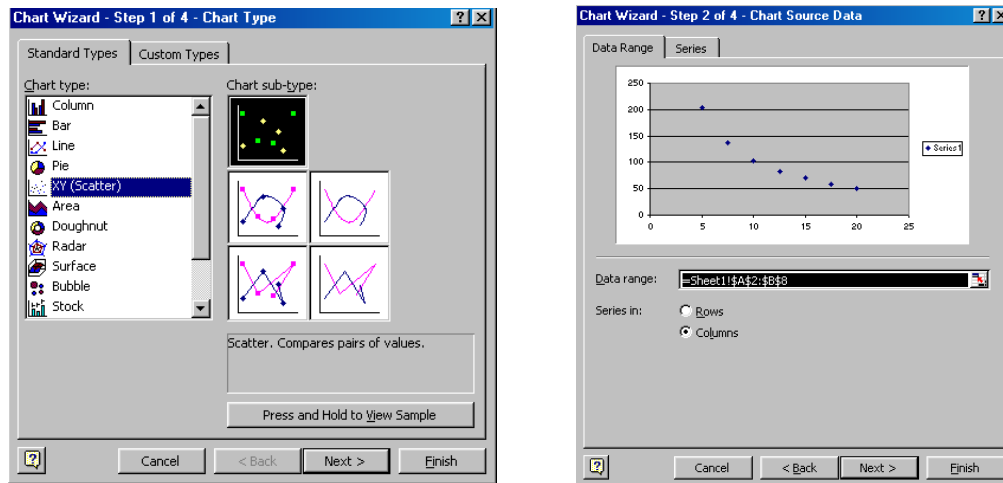
Look at the data set below. Just by looking at the data, you can start to see a trend but you may not get the complete picture. We will use a spreadsheet to graph the data and determine the equation for the straight-line relationship.

Volume (mL)	Pressure (kPa)
5	204.626
7.5	136.755
10	103.326
12.5	82.053
15	69.897
17.5	58.754
20	50.650

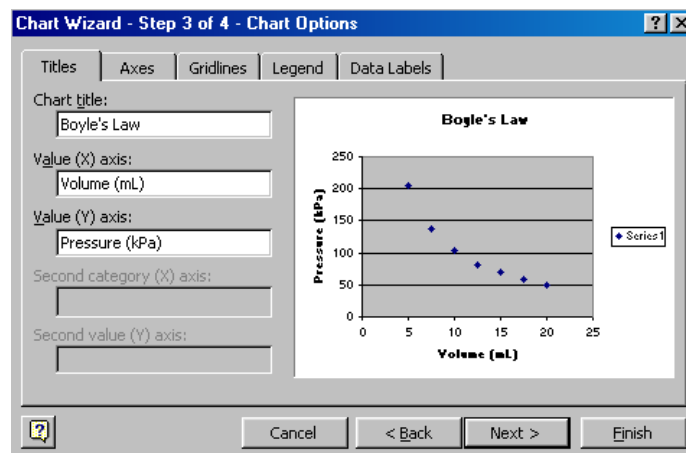
1. Open an Excel spreadsheet from the computer desktop and begin by entering Volume and Pressure into cells A1 and B1 respectively (do not forget units). These cells will serve as titles for the two columns of data. Enter the data into cells A2 through B8. It may be necessary to resize the columns to prevent overlap of the titles. To resize, place the cursor between the A and the B until you see the double arrow appear and drag the box to change the size. This data will now be used to create a graph. In Excel, a graph is called a chart.
2. To start the process, click **Insert** on the toolbar and choose **Chart**. This will begin the chart wizard, which will allow the creation of a graph with just a few simple steps.



- Now choose the type of graph. For this exercise, choose the “XY (Scatter)” with no lines. This will graph each data entry as a point on a coordinate system. Click “next” to proceed to the next step.



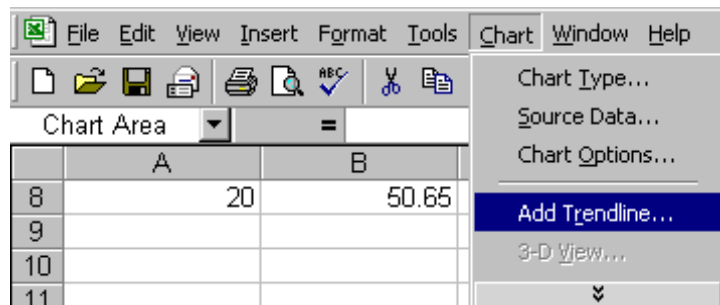
- Excel needs to know where to find the data to be graphed. At the prompt for data range, enter “A2:A8,B2:B8”. This tells Excel that the values for “X” are found in cells A2 through A8 and the values for “Y” are in cells B2 through B8. Click the box which says “Series in columns” and the wizard will show a preview of the graph. Click next.
- The third step allows the graph to be customized. For now, just name the graph “Pressure v. Volume”, label the x-axis “Volume (mL)” and label the y-axis “Pressure (kPa)”. Excel will add this information in the preview window. Click “Finish” and Excel will insert the graph into the spreadsheet.

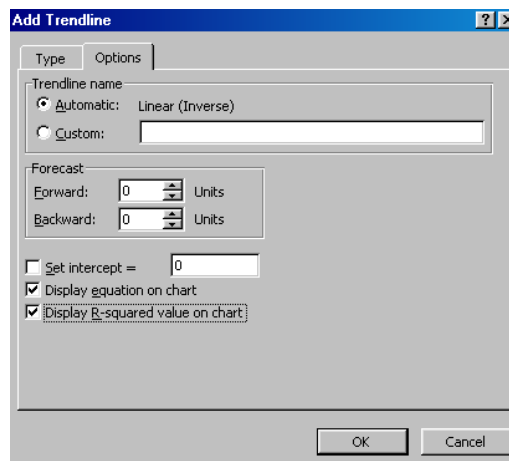
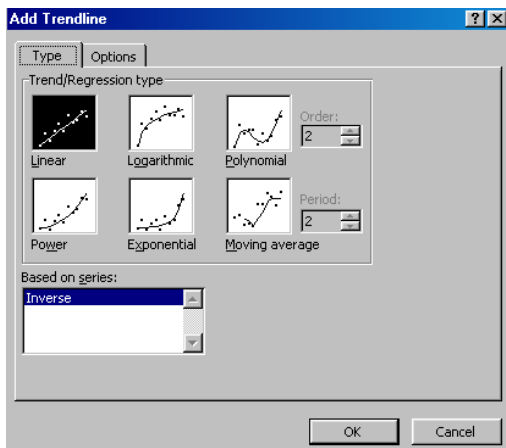


The toolbar on top of Excel is a little different now. It says “Chart” where it used to say “Data”. It will change back to “Data” when you click anywhere in the spreadsheet and then change to “Chart” when you click on the graph. **Have your teacher check your graph before continuing.**

- What type of relationship is shown on the graph? _____

7. This is not a linear relationship. While some things have a natural linear relationship, most do not. Nonlinear relationships can often be represented with a linear model. There are many mathematical methods available to manipulate data. It helps to be able to recognize the relationship in order to choose the best method. This looks a lot like an *inverse relationship*.
8. One way of describing an inverse relationship is to say that when matching data points are multiplied, the product is always the same number (called a constant, k). Test this by multiplying the number in A2 by the number in B2. Do this in cell C2. Wait! Don't pull out that calculator! Excel will do the math for you. Place the cursor in cell C2. In order to tell Excel to do math, type an equal sign. The formula should be $=a2*b2$. Recall that computers use the star key, $*$, to multiply. Repeat the process for the rest of the data; remember to change the formula accordingly. **Hint** – you can copy and paste in a variety of ways that will change the formula for you automatically! Ask and your teacher will show you. Are the products all the same? Close? Close enough?
9. Now linearize the data. We will work below so that we can keep the data for the two graphs easily separated. Copy cells A1 through A8 to cells A21 through A28. (Do you know how to use copy and paste in Word? It works the same here. You can also use the mouse to highlight the data, hold the CTRL key and C down to copy then move to the new location. Hold CTRL V to paste.) In cell B21, enter the title "Inverse". In cell B22 enter the formula $=1/B2$ ". What are the entries for cells B23 through B28? Complete the chart.
10. Follow the steps above to graph the new data set. Label the x-axis "Volume (mL)" and the y-axis "Inverse of Pressure (1/kPa)". What type of relationship do you have now? If it was not linear, we would do other transformations like logarithms or x^2 .
11. Excel will add a line to fit the data that we have transformed. With the graph selected, click "Chart" and choose "Add Trendline". Choose "Linear" and then select "Options". Several selections are possible. For now, check the boxes "Display equation on chart" and "Display R-squared value on chart". With these selections checked, click "OK".





The graph now has the equation and something called “ R^2 ”. Their location on the graph can be moved. The value for “ R^2 ” gives an idea of how close the line fits the data (the closer to “1” the better).

12. Have the teacher check your results. You may now move on to Model I – Boyle’s Law where you will analyze your own laboratory data.