Making Best-Fit Line Graphs *(Scatter Plot)* Using Excel (2010)

You will be using Microsoft Excel to make graphs this year. This tutorial is designed to help you learn some of the more common features of Excel used in Chemistry and Physics. There are other tutorials you can use as well. Feel free to Google other tutorials that may more sense to you. A great video tutorial can be found here: http://www.sophia.org/tutorials/excel-xy-scatter-plot-graph

IMPORTANT CAUTION: You will NEVER simply "connect the dots" when we make a graph—we do linear regression which generates a line that fits **among** the points. They're called XY Scatter Plots. Sometimes the line hits all the points, sometimes it doesn't, Remember that how far off the line your data point is gives you an indication of your error.

Okay, let's get started! First you should familiarize yourself with the layout of the Excel spreadsheet. Open one up and take a look. By default, column "A" is x-axis data and column "B" is y-axis data.

Let's say that you have some XY data and would like to make a graph and you need a best-fit line.

- **Enter your data** into the appropriate columns placing your x-axis data first and y-axis data second. Be sure and keep the X and Y data straight!! Look at the image below for an example

- OPTIONAL: If you have multiple sets of data in one graph, more than one set of dependent variables, use Row 1 to title the different sets in the y-axis column - for example, Trial 1, Trial 2, etc. Then enter your data under that.


IMPORTANT: Before you do ANYTHING else: We will always be using **XY Scatter Plots**. The most common mistake made by students is choosing the Line Graph—don't do it!!!

Right. Go ahead and click on the very bottom right number you entered in your last column.

- Then, in the ribbon at the top of the Excel page, click on "Insert"

- Then choose "Scatter"

- Then select the graph with **no line** on it – just dots.

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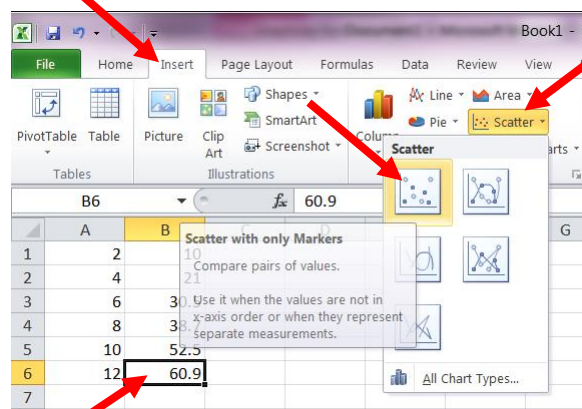
- A graph should appear on your page that looks like this. If you only have one set of data for your graph, click on the "Series 1" legend – usually on the right side of the graph, and delete it. Leave the legends if you have more than one set of dependent variables.
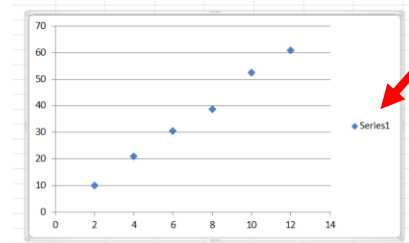
Now that you have a graph, let's add axis labels and a title. Follow the examples below:

- Click on "Layout" at the top, then "Axis Titles" and then select Primary Horizontal Axis Title, and then **Title Below Axis**. Double click inside the title that pops up and type in both the quantity and the unit symbol that were measure.

- Do the same thing for the vertical axis. Choose Primary Vertical Axis Title, and then **Rotated Title**. Type in BOTH the quantity and the unit symbol.

- Optional: Sometimes your units need superscripts. To change a font to a superscript, select the number or letter you want to make a superscript. Click on the Home tab at the top of the Excel page, and in the Font box, click on the bottom right arrow to open it, and then select Superscript.

- Now add a title for your graph. Go back to the Layout tab at the top of the Excel page and do the same thing for "Chart Title" and select the option "Above Chart".

- The title should say Graph of Y vs. X (substitute the Y variable quantity and the X variable quantity.
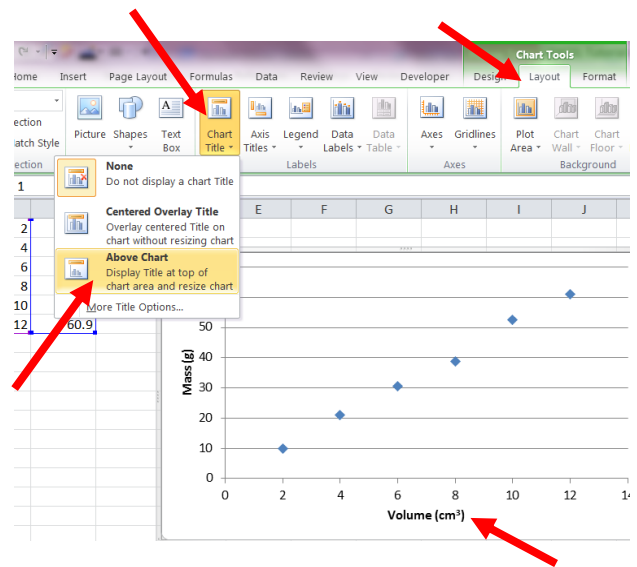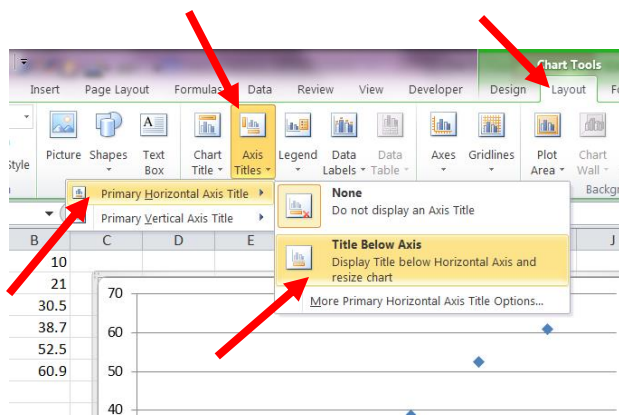
It is now time to add the line! Remember you are NOT connecting the dots, but creating a best-fit line. So, right-click on any data point on the graph and select "**Add Trendline**".
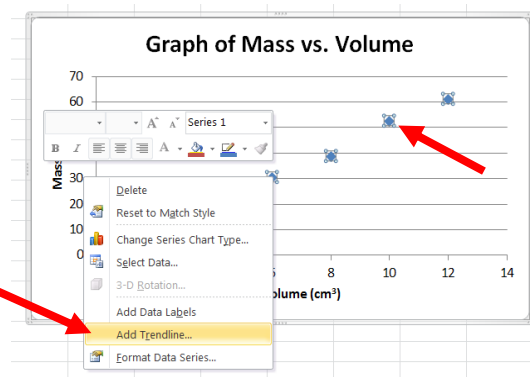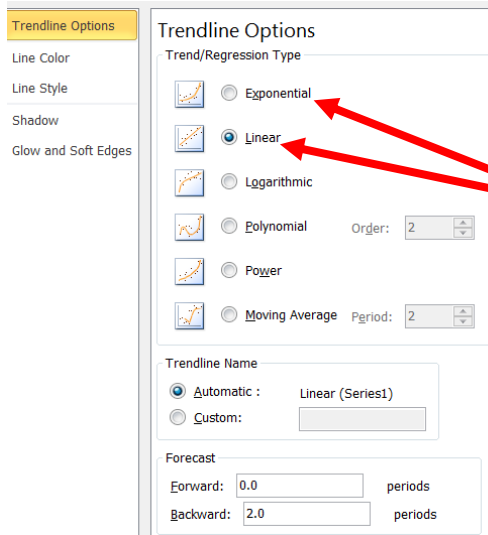
The Trendline menu has several options. First, we are interested in a best fit line for this graph, so examine your data points closely:

- If you have a direct proportion that looks like it is supposed to be somewhat of a straight line, choose "**Linear**".

- If you have a direct proportion that looks like it is supposed to be parabolic, choose "**Exponential**".

- If you have an inverse proportion, choose "**Exponential**".

Your graph should now look something like this. Delete any legends that may appear on the right; however, if you have multiple sets of data, multiple trials in one graph, you will need to include the series legend that labels the set of points. Do not keep the line legends!!
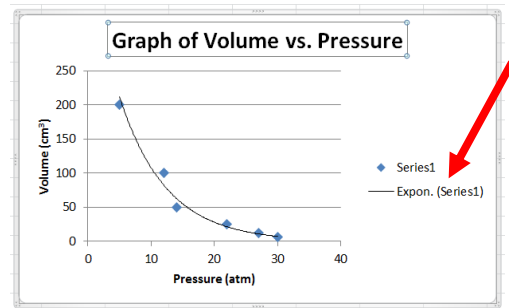

If you have a linear or parabolic graph, your line must intersect with the y axis or x axis (whichever fits).


- Double click on your line to open the Trendline Options menu, or right click on it, and select "Format Trendline".

- You will notice that there is a "Forecast" section in the Trendline menu. This is used if you need to extrapolate your line forwards or backwards.

- You simply add a number, however much the line has missed the axis – usually in the "backwards" box. For example, for the graph above, I added "2" two the graph on the left because it missed the axis by 2.

- Look to see what happens to the graph. Notice the line has been extended backwards. To increase the distance it is extended, increase the value. To decrease the distance it is extended, decrease the value. If you need the other end extended, use forecast forward.

- If a negative number pops up on the X or Y axis, double click on the negative number and an **Axis Options** box will pop up. In the Minimum Value box, check Fixed and enter 0 for the value.
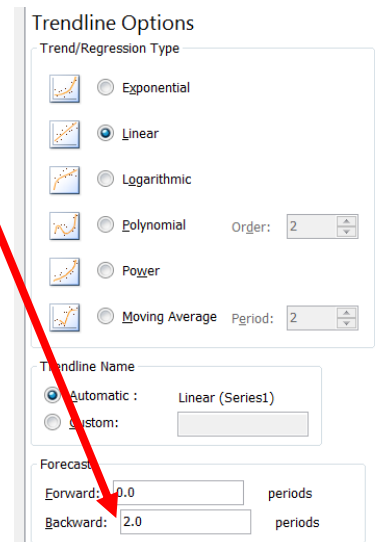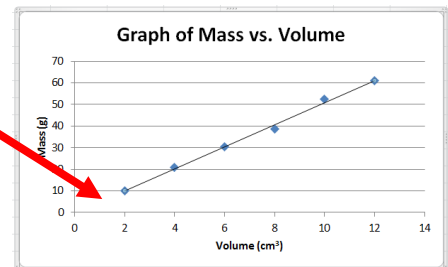
Your graph should now look like this:

Graph of Mass vs. Volume
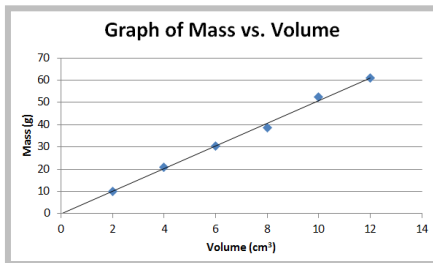
There are now other things that you can do to the graph to make it look nicer or easier to read such as grid lines in the background or adding tick-marks or re-scaling the axes.

Graph of Position vs. Time
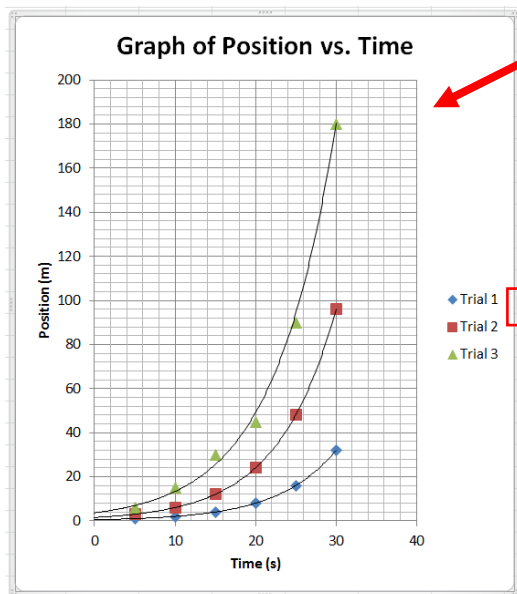
- Gridlines: Click on "Layout" at the top and then "Gridlines" and then for both Primary Horizontal AND Primary Vertical Gridlines, select Major & Minor Gridlines,

- Size: Make your graph larger or smaller by stretching the size bars at the top, bottom, left, and right of the graph. Make sure you stretch the graph to scale, with the largest side of the graph being the one that has the greatest range of numbers.

- Equation: You can display the equation of the graph (and the slope of the line). Double click on the line – or go to the Layout tab and click on the Trendlines format button. Check the box at the bottom that says "Display equation on chart".

- Fonts, colors, shapes, tic marks on the axis: All of these can be changed by right clicking on whatever you want to change, and then selecting the Format option.

Now you need to put your graph in your lab report!

- Right click inside the graph and select Copy.

- Go to Word and Paste the graph into your document.

- Orient the graph to match the orientation of the paper. For example, make sure the short side of the graph is on the short side of the paper. To rotate your graph, double click on it and then click on Rotate in the menu ribbon at the top of the page.

- Finally, in lab reports, your graph must be a full page. To change the size, double click on the graph and pull the tabs at the CORNERS – this keeps the proportions the same. Do not pull the tabs at the top, bottom, left, or right – this will cause your graph to be skewed.

You are done!! We've just hit the highlights of what Excel can do with graphs. Feel free to explore to find other great ways Excel can work for you!!