

Tips for Graphing

Note: Check with your instructor for specific requirements.

Graphs in General Chemistry should contain:

- Axes
- Axis labels – what did you measure (put units in parentheses where possible)
- Data points that are clearly visible
- Trendlines for data that is linear
- Captions (optional)

Excel is available in all campus labs, so that's what will be described here. You can use other programs if you are proficient with them. Remember lab reports are INDIVIDUAL efforts. Hitting the print button twice and giving a friend a copy of your graph is an Honor Code violation. You must turn in legible, computer-generated graphs.

Step one: Figure out x and y

Think about why you are drawing the graph. In general, the variable you controlled in lab goes on the x-axis, and the variable you observed goes on the y-axis. So if you add drops of solution X to a beaker and measure the pH, "volume of X (mL)" would go on the x-axis and "pH" would go on the y-axis (pH is a unitless quality, so you won't have units to include). Sometimes it also helps to think about the units for the slope. Remember, rise over run = slope, and "miles per gallon" is a more meaningful unit than "gallons per mile".

Step two: Input data

There are lots of ways to do graphs in Excel, but it's probably easiest to put data in columns. Make the first row your axis label. Put the x data first, then y.

Try an example. Figure out how to graph the following data. We can fly from Atlanta to:

State College, 600 miles, cost \$358

Barbados, 2112 miles, \$589

New Orleans, 429 miles, \$158

Belize City, 1153 miles, \$668

***** Don't look past this line until you've got the data in Excel*****

We can choose what cities we go to, but we don't get to choose the price. So the distance is our dependent (x-axis) variable, and the cost is what we observe so the data should look like:

	Distance travelled (miles)	cost (US Dollars)
State College	600	\$358
Barbados	2112	\$589
New Orleans	429	\$158
Belize City	1153	\$668

Graph types

Excel has 5 basic graph types. Most are self-explanatory, but “Line” and “Scatter” can be confusing. Look at the following examples, which do you think is the correct type for this graph?

The screenshot shows the Excel interface with the following data table:

	Distance travelled (miles)	cost (US Dollars)
1		
2	600	\$358
3	2112	\$589
4	429	\$158
5	1153	\$668

Two charts are shown below the table:

- Line Chart:** The x-axis is labeled 1, 2, 3, 4. The y-axis ranges from 0 to 2500. It plots two lines: a blue line with diamond markers and a red line with square markers. The blue line starts at approximately 600, peaks at 2112, and ends at 1153. The red line starts at 358, peaks at 589, and ends at 668.
- Scatter chart:** The x-axis ranges from 0 to 2500. The y-axis ranges from \$0 to \$800. It plots four data points as blue diamonds: (600, 358), (2112, 589), (429, 158), and (1153, 668).

Arrows labeled '1' and '2' point to the 'Insert' tab and the 'Scatter' chart option in the ribbon, respectively.

The “Line chart” makes no sense. It ignored what we want the x-axis to be and plotted all the data on the y-axis. Line charts are used when the x-axis has no numeric value. In General Chemistry, you should NEVER turn in a Line Chart.

Step 3: Draw a Graph

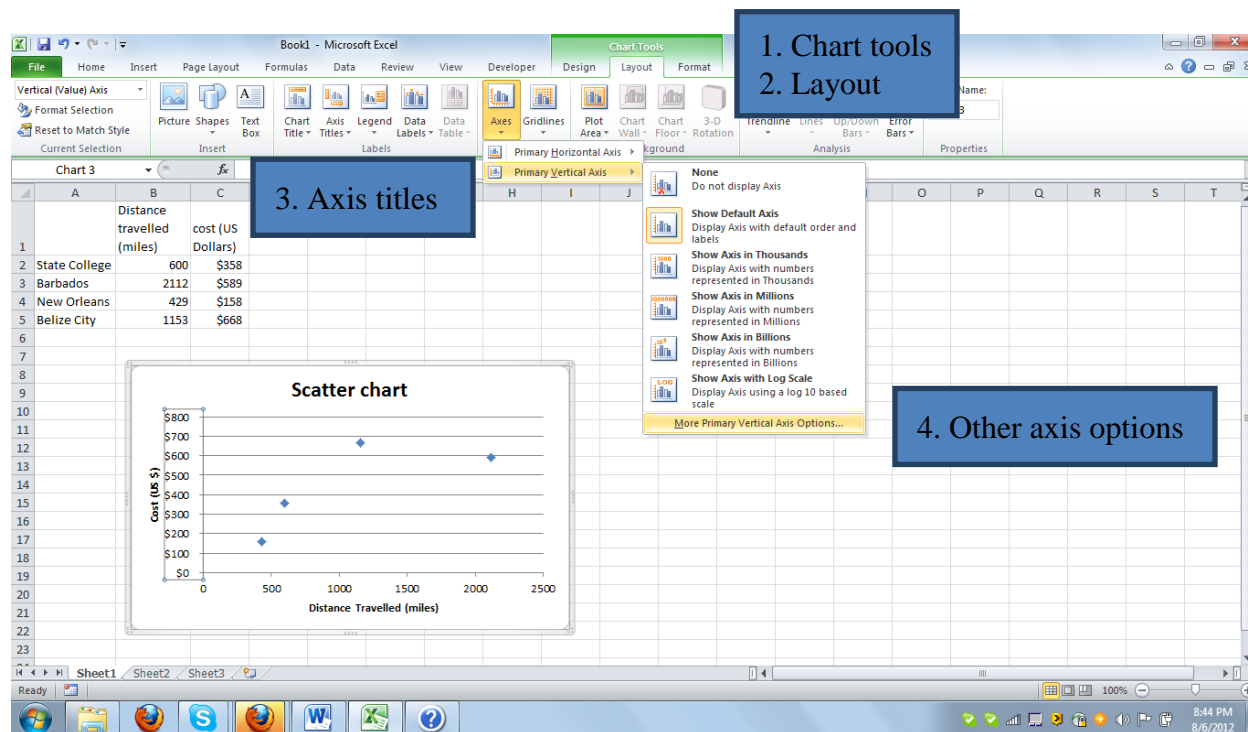
To make the “Scatter” chart, which does look at the x-axis values, highlight your data, go to the “Insert” tab (arrow 1), and select “Scatter” chart (arrow 2). You are NOT done.

Step 4: Legends

When you have lots of different experiments on one graph, you should use meaningful legends. If you only have one data series, delete the legend. The values in your header row become your legend text.

Step 5: Axis labels

To add titles to your axes, go to “Chart Tools”, “Layout” tab and insert both horizontal and vertical “Axis Title”. You can also go to “Axis”, choose a direction and then click “other axis options” at the bottom to change where the axis starts, how many spaces are shown, etc.



Step 6: Add a Title or Caption (Optional)

You can change your Chart Title to something meaningful. Titles are used on graphs for visual impact, like posters or powerpoint slides. But for lab reports and papers, scientists generally use captions, not titles. Neither captions nor titles should ever repeat what the axis labels say, that information is already provided. A title should summarize the point of the graph in a few words. A caption should summarize what’s important for the reader to know about the experiment. Be sure to select an appropriate font size and include punctuation.

Step 7: Add One or More Trendlines (When Necessary)

There are 2 types of lines you can draw in Excel, “connect the dots” and trendlines. Connecting data points can help with visualization if you have collected a LOT of data. For General Chemistry if you need a line, you will need a trendline.

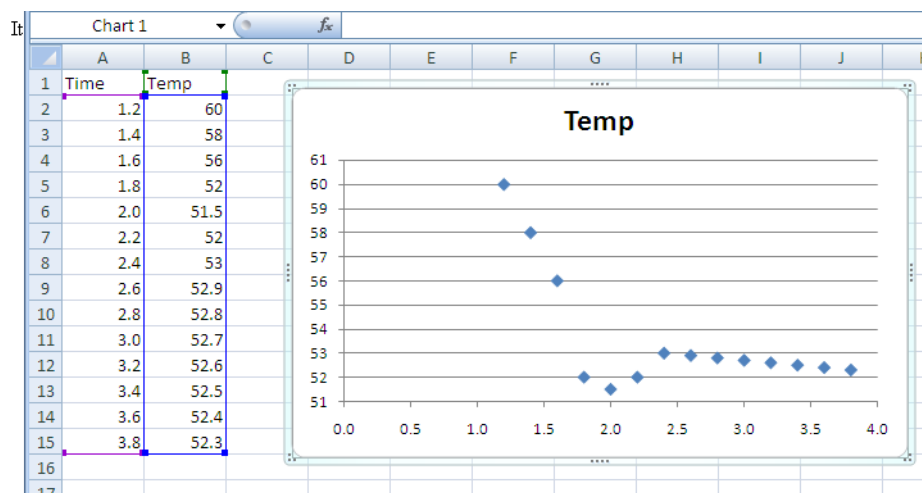
Trendlines use an equation to match (provide a “best fit” to) your data. Most relationships we’ll study are linear. (If the theory provided in your textbook says there should be a linear relationship

but your graph looks like a parabola, you likely did something wrong.) For General Chemistry, always use the trend line that is theoretically correct. (You can also use linest function if you know how to work with arrays (control-shift-enter).)

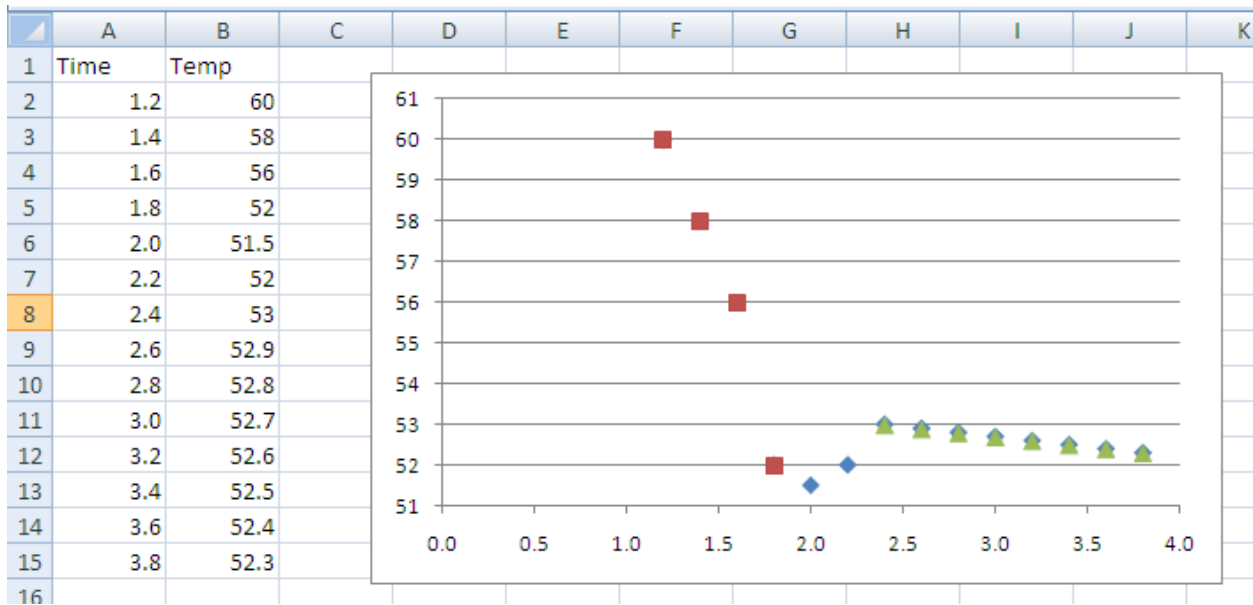
Try this function by right clicking on the data and selecting “Add Trendline.” Toward the bottom are options to display the equation and display the R-squared value. R^2 is a linear regression parameter that tells how close your line is to your data. 1.0 is a perfect fit. You can change the format of the numbers displayed by highlighting the one you want alter, right clicking, and selecting “Format Trendline Label”. In this case, 0.56 is a terrible fit (the definition of *good* varies depending on the kind of data. For a simple data trend 0.95 is generally the standard.) This makes sense because airline prices are pretty random and not expected to be linear. You can use the “Forecast” options to extend the line, if needed.

Multiple lines

If you need multiple lines (for example, before and after melting), you have to insert different data sets. For the following data set, the first 4 points are in a line, and the last 8 points are in another line:



To draw the lines, right click on the chart, choose “Select Data”, then “Add”, and select the first 4 rows, being sure to keep x and y straight. Then “Add” a different line for the last data points. If the middle data points aren’t linear, don’t include them in either line:



Now right click on the red data points, and add that line. Then right click on the green data points, and add that line. You can “Forecast” forwards and backwards if you need to see where your trendlines intersect.

Step 8: Print Graph(s)

Print each graph as a full page. Select the graph, and go to File in the upper left and chose print. It’s ok to print multiple graphs on one page if what you are trying to show is clear. It is not ok to turn in sloppy or illegible graphs. You have at least a full week to do lab reports; do not put them off until the last minute. Email your instructor if you have questions.