

Graphing with Excel™

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There are many spreadsheet programs and graphing programs that you can use to produce very nice graphs for your laboratory reports and homework papers, but Excel by Microsoft is the one most students choose to use. Unfortunately, it is set up to do charts for business use and not good graphs for science. We can force it to do a better job for us if we make a few changes to the default settings. (Look at the handout “How to Make a Good Graph for a Science Class” available from you teacher or <http://morganchem.com>)

To see how to use Excel to make a good graph, follow along on your computer and work through the following example problem.

One day Fred and Zelda were trying to find the density of water so they got a balance and a graduated cylinder and got to work. They found the mass and the volume for ten different samples of water and recorded them in a neat data table:

Data Table

Volume of Water	Mass of Water (g)
10	9.94
20	20.07
30	30.15
40	39.98
50	49.91
60	60.04
70	70.08
80	79.96
90	90.11
100	100.95

Post Lab Questions:

1. Construct a graph of volume (x-axis) versus mass (y-axis) for the data in table 2. Label the axes (volume and mass not x and y), title the graph, include units, and draw the line as smoothly as possible. Use a computer to generate the graph. It should fill the entire page. Staple it to this page.
2. What physical quantity does the slope of the line on your graph represent?
3. What are the units for the slope of your line?

“Now what do I do?” you might be saying to yourself.

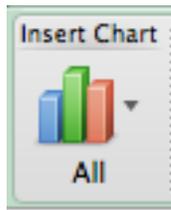
Step 1: Turn on your computer and run Excel and start a new “Workbook” (that’s a spreadsheet in Excel-talk). Go ahead, I’ll wait right here.

Step 2: Type in the data table you see above exactly as it is there. Important! You need to put the values for your x-axis (the volume) in the first column and the values for the y-axis (the mass) in the second column because that is the order Excel will use in making the graph. Double check that you’ve gotten all the numbers correct.

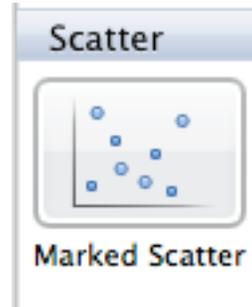
Step 3: Select all of the numbers...

	A	B	C
1	Volume of W	Mass of Water (g)	
2	10	9.94	
3	20	20.07	
4	30	30.15	
5	40	39.98	
6	50	49.91	
7	60	60.04	
8	70	70.08	
9	80	79.96	
10	90	90.11	
11	100	100.95	
12			

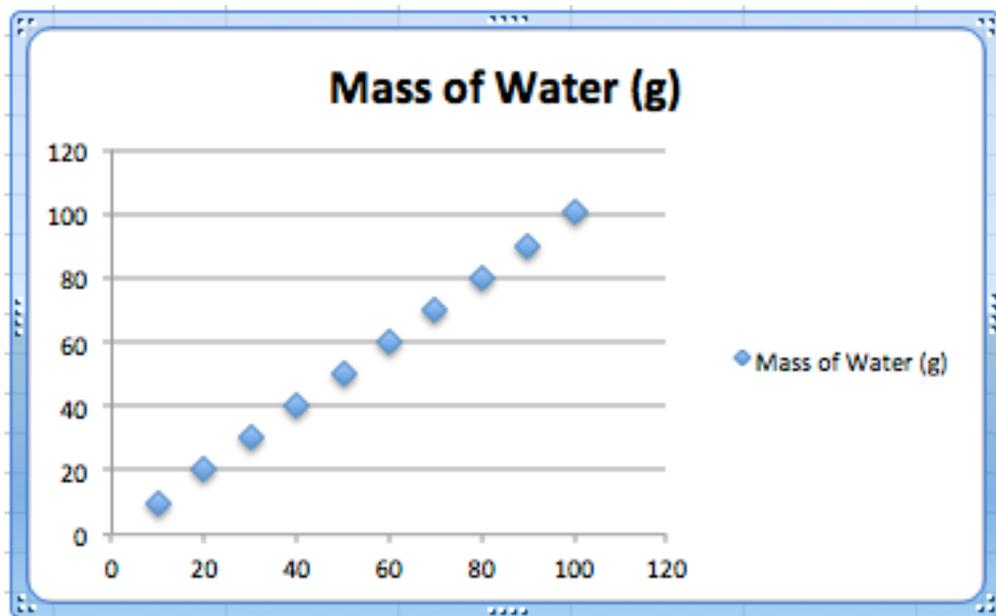
Step 4: and then click on the Charts tab  or use the Insert menu and select “Chart...”

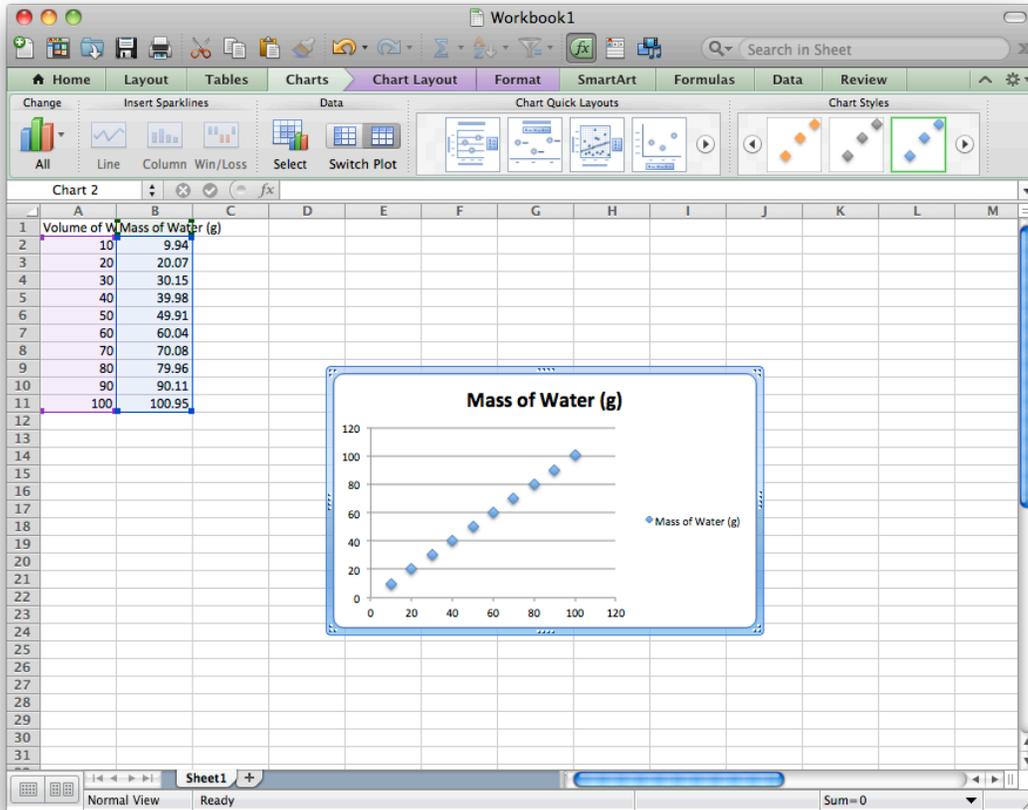


Step 5: Click the Insert Chart button and then scroll a long way down the list of choices until you get to the section labeled “Scatter” and select “Marked Scatter.”

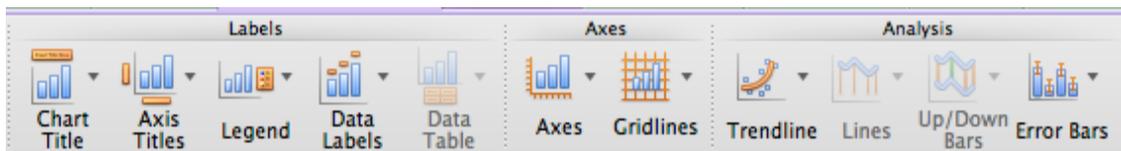


You will see a cute little graph appear:





Step 6: Click “Chart Layout”:  and a new set of buttons appears in the ribbon display:



Now we just need to go down the line and fix up our graph.

Step 7a: Click “Chart Title” and enter the Title for your graph, if it is not already there. (You may edit the title by clicking on it and typing your new title.) Let’s call our graph “Density of Water.”

Step 7b: Click “Axis Titles” and add labels for the axes including units!

Step 7c: Click “Legend” and select “No Legend” for this graph. A legend would be useful if our graph had more than one line on it, but with only one line it is not needed.

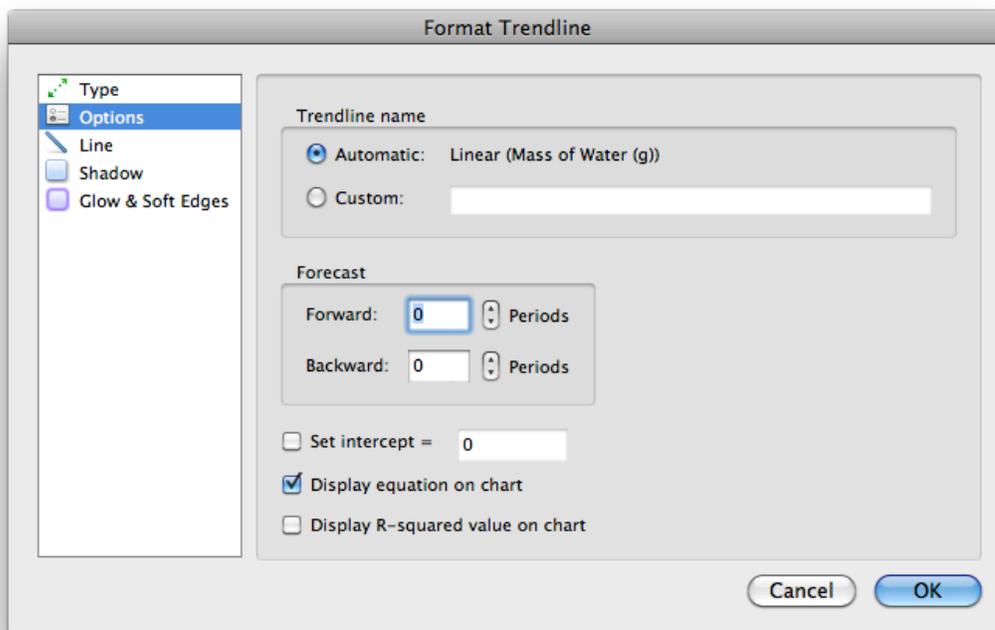
Note: do NOT select Data Labels. We don’t need a bunch of numbers cluttering up our graph when all we have to do is look at them in our data table.

Step 8: Click “Gridlines” and select the “Vertical Gridlines” then “Major Gridlines.” Line graphs need both horizontal and vertical gridlines, or non at all.

Look at your graph. See how the data points make a pretty straight line? Let’s get the computer to draw a best-fit line (a “trendline” in Excel-talk) on our graph and also tell us the equation of that line.

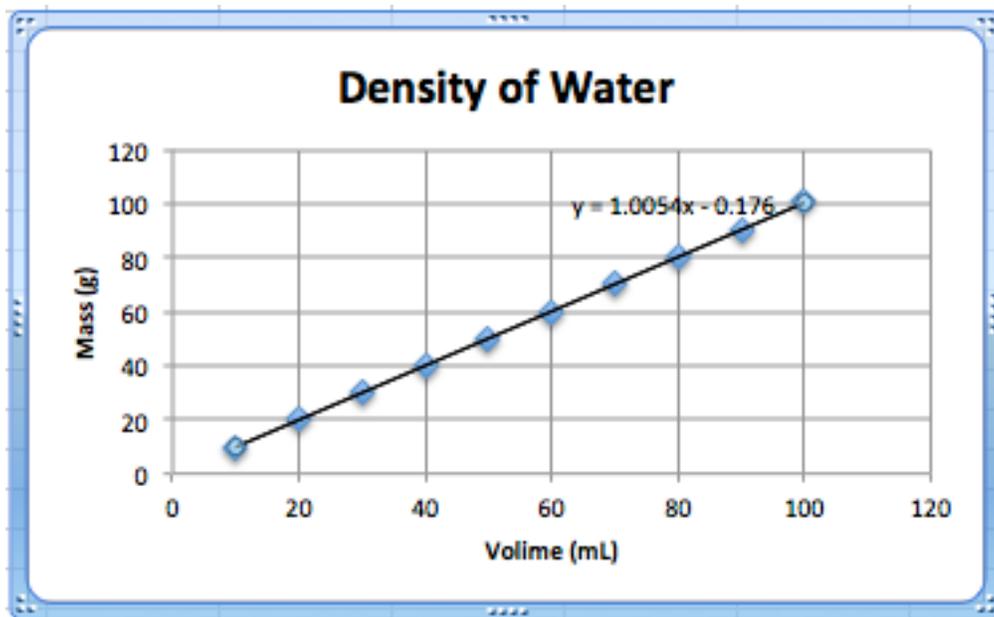
Step 9a: Click “Trendline” and select “Linear Trendline” because that’s good for this graph. The other choices are good for graphs that curve. Advice: never select “linear” if your graph looks like it is a parabola!

Step 9a: Click “Trendline” again and select “Trendline Options...”, click on “Options” at the left side of the “Format Trendline” dialog box:



Select “Display equation on chart” so that you can see the equation for your straight line.

At this point your cute little graph should look like this:



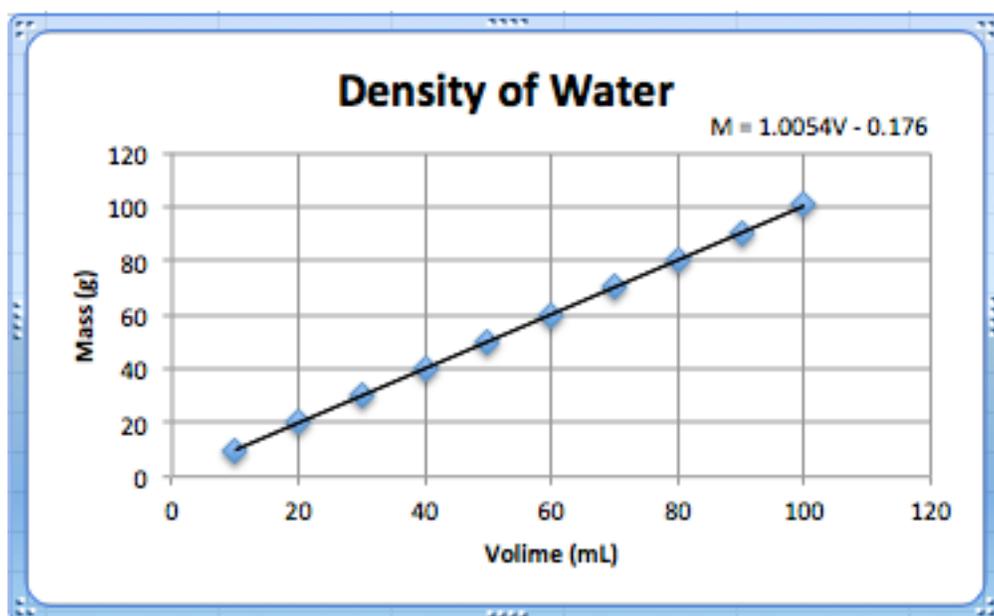
You now see a rather pretty graph with a nice straight line through the data points and the equation of that line: $y = 1.0054x - 0.176$

You can click on the equation and drag it around your graph until you get it in a good location where it will be easy to see and read.

You can also edit that text! Since we have a Volume-axis and a Mass-axis let's change our equation to be:

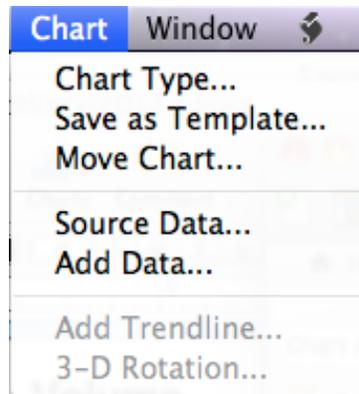
$$M = 1.0054V - 0.176,$$

where V is volume and M is mass.

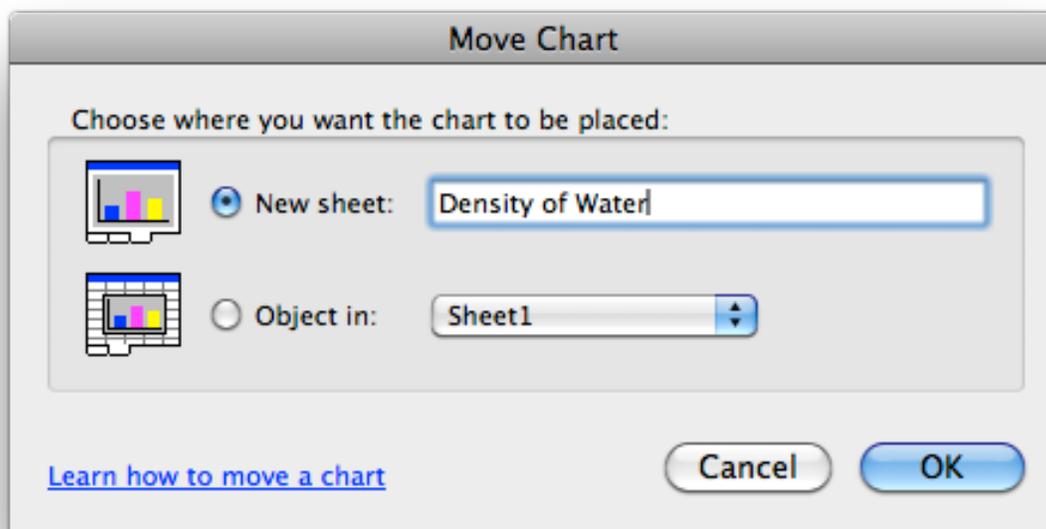


Step 10: SAVE YOUR WORK NOW!!! The version of Excel installed on the computers at school has a bug that sometimes causes a crash during the next process. Ouch!! I'm sure this bug will be fixed at some point, but it is better to be safe than sorry.

Step 11: Now it is time to move your graph onto its very own page.



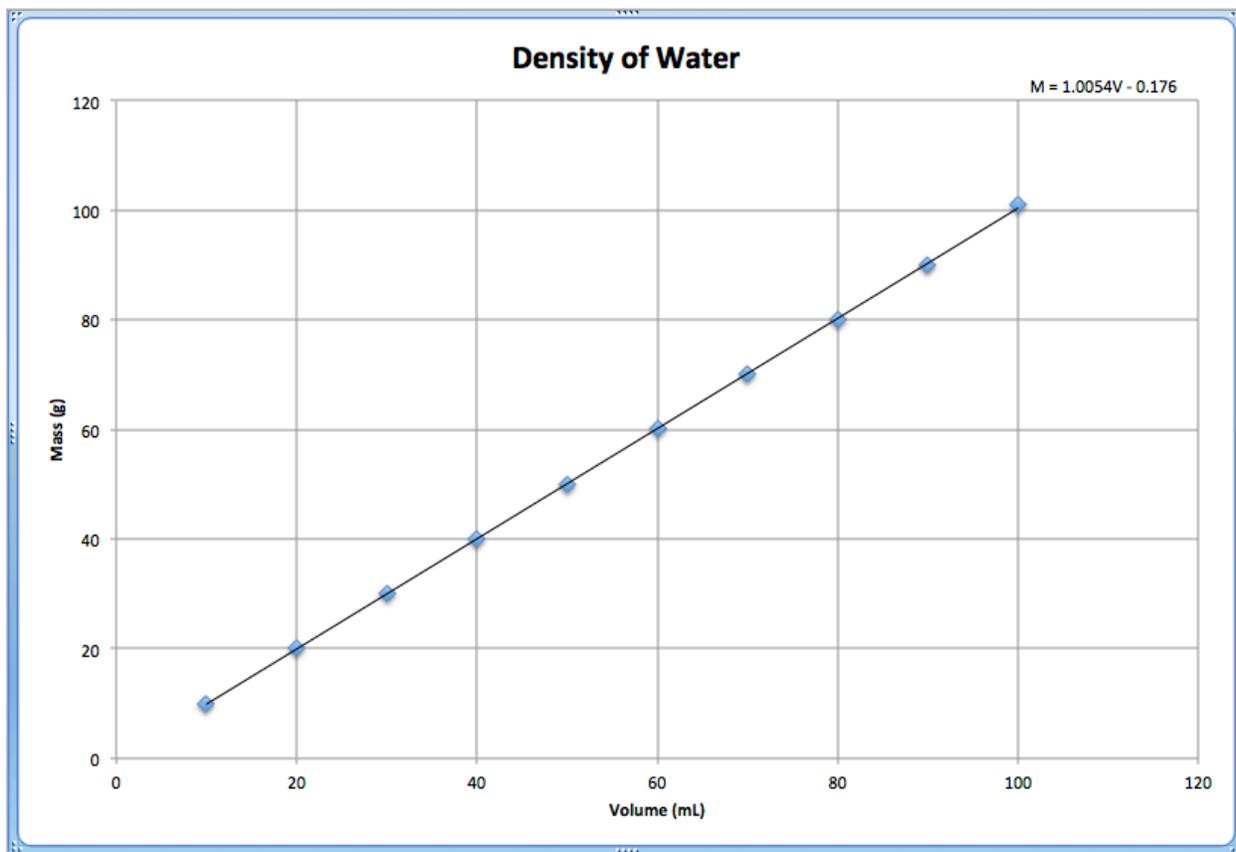
Click on the “Chart” menu at the top of the page and select “Move Chart...”.



Select “New sheet:” and change the name, if you wish, and then click “OK.”

If you plan to print your graph on school computer, please format the plot area to have no “fill”, that is no shaded background to save us ink. Then remember to save a copy of your file as a “pdf” in case the version of Excel at school does not understand the version you have at home.

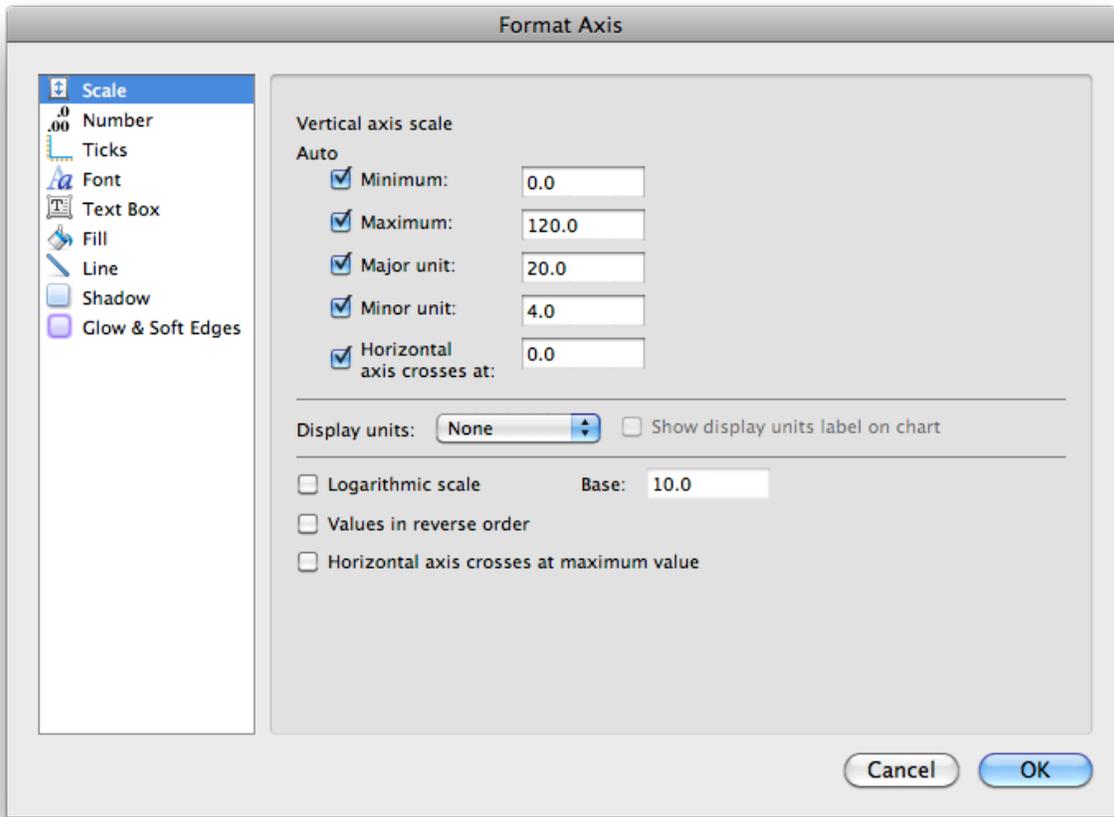
Here is what the final product should look like:



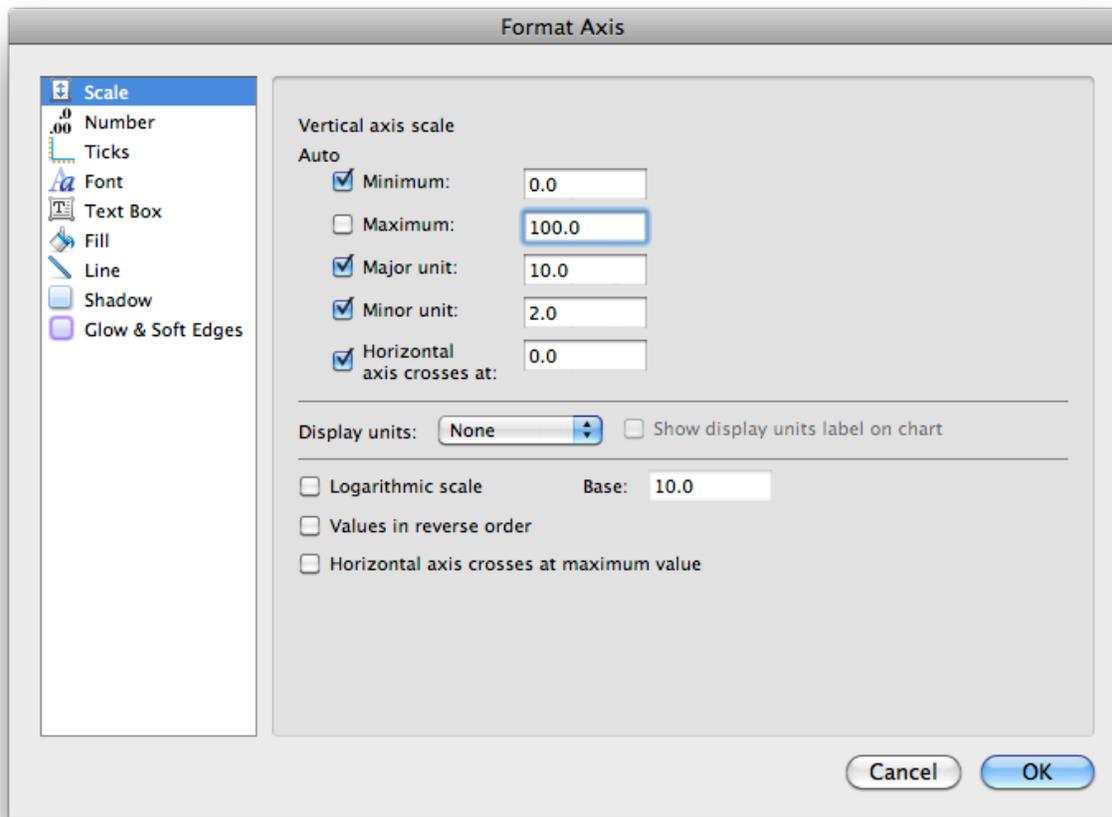
[Can you answer Post Lab Questions 2 and 3?]

Of course there are always a few more things you can do to make it look better, but this is good enough for now, so save your work.

If you right-click on an axis, data point, trendline, etc., you can format it differently. For example, you can change the scale of the y-axis. To do this, right-click on one of the numbers and select "Format Axis...."

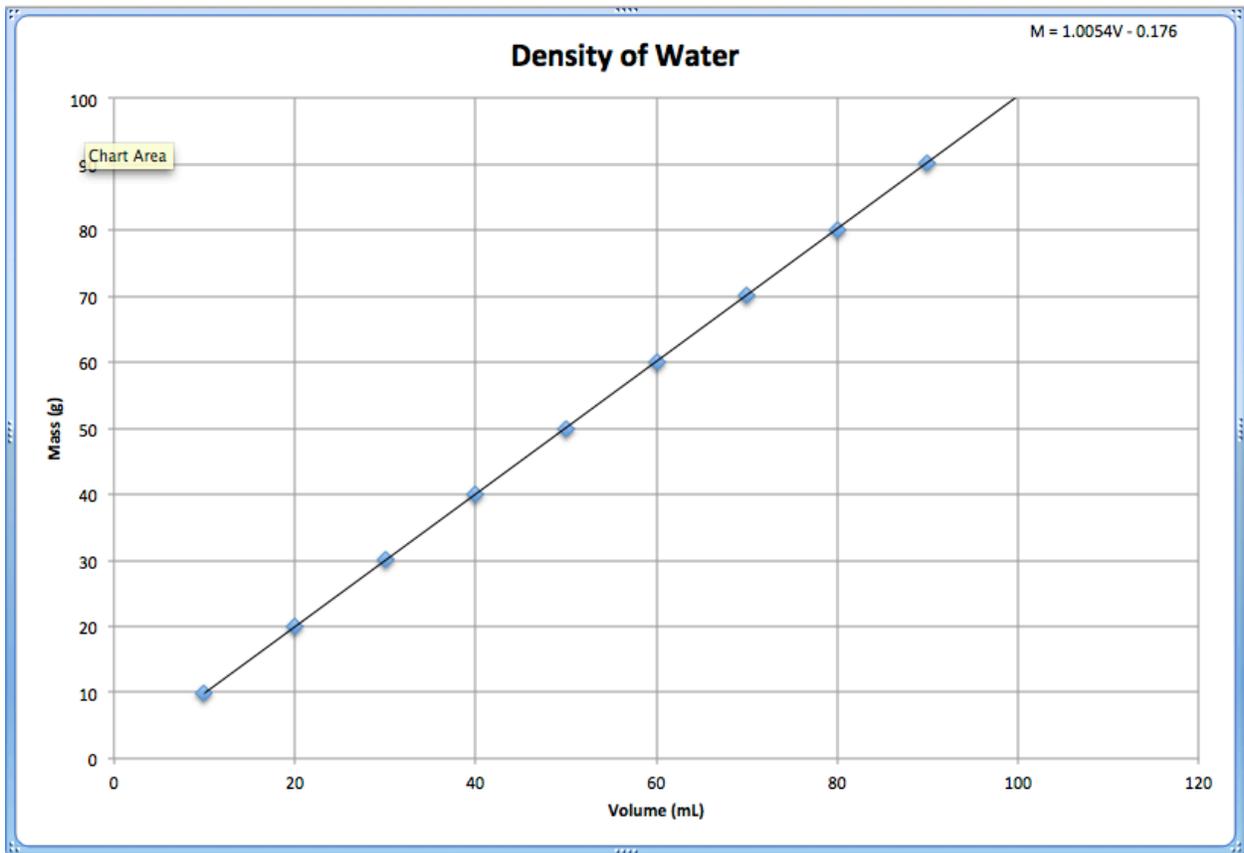


Click on “Scale.”



I changed the y-axis maximum value from 120 to 100 and the major unit from 20 to 10 to match what is in our data table. Look at the other tabs and see what they do. Hey, you've already saved a good version of your graph, so feel free to explore and save your new creations with different names— "Density1", "Density2", and so on, then print the best one to turn in.

Click "OK" to see the results.



What do you think? If you think the first way was better, you can always change your mind reverse the changes. You have been saving your work as you go along, right?

Practice, Practice, Practice

Try this one, just for practice.

Charles fills a very strong balloon with pure, dry nitrogen gas. He then makes a series of very careful measurements of the temperature and volume of the balloon. As the the temperature rises, the size of the balloon increases. Charles' data is recorded in a neat table shown below:

Temperature (°C)	Volume (mL)
20	258
40	275
60	293
80	310
100	328
120	345
140	363
160	381
180	398
200	416

Is your graph a straight line? If so, what is its slope? What are the units of the slope? What would be the volume of the gas at 0° C?

Don't peek!

[Answers: yes, 0.8791, mL/°C, 240 mL.]