



Graphing Using Excel®

Excel® is a spreadsheet application that will help you to organize and graph data. It is particularly helpful in its capacity to perform customized functions, such as formulas or commands that you direct the computer to execute. Examples of these functions include summing numbers in a column or calculating the average of a column of numbers.

Entering Data

When you open Excel®, it should come up with choices to select. Select and open “Blank workbook” hit “Create”, to see the new untitled “Workbook 1.” If not, go to **File** and select “New Workbook.” The “Workbook1” you see on the screen is a blank **spreadsheet, ready for you to record data**. Go to **View** and select **Normal** to get a continuous view of the worksheet. Each worksheet is contained in a workbook; the *workbook title* appears at the top. It will default to say, “Workbook 1” until you save it with the title you want. Along the bottom edge of the worksheet, you will see tabs labeled “sheet 1” “sheet 2” and so on. This tells you what sheet you are in, since you can store many sheets of data in one workbook. Double-clicking on the “sheet #” tab at the bottom of the workbook will highlight it and allow you to change the name of the sheet to something that makes sense for you.

Each worksheet contains **columns** (lettered across the top) and **rows** (numbered down the left side). The intersections of rows and columns form **cells**, which are the basic units for storing data. **Each cell is named from this intersection**; for example, the cell formed by the intersection of column C and row 5 is referred to as cell C5. To enter data in a cell, you first must **activate** it by placing the mouse pointer on the cell and clicking. The active cell now will be **highlighted**. Before entering data into the cells of the spreadsheet, it is a good idea to reserve a single column at the left edge of the table for **row headings**. Likewise, you should leave the first row empty for **column headings**.

Formulas and Functions

You must let Excel® know that you intend to enter a formula (rather than actual data). This may be accomplished in various ways:

1. In the cell in which you want to enter a formula, type in the equal sign (=), followed by cell location where you want to start your equation and one of the commands listed below and then the cell location of the other cell you wish to have in the equation. You will notice that a dialog window (labeled “fx”) above your workbook will show your equation. You can always go there to revise or modify any equation. Then press the Return or Enter key to execute the command.

For example, to create a function for cell A10 that sums all of the numbers in that column you would enter this formula followed by the Enter key:

=A5*B1

Example Mathematical Functions:

- + (addition)
- (subtraction)
- * (multiplication)
- / (division)
- ^ (raising a number to a power)

2. An alternative method may be used to enter a formula. If you want to perform a mathematical function, you start with an equal sign (=) in the cell location where you want the answer to your equation. Once you type an equal sign, you will notice that next to the “fx” dialog box there is a pull-down menu from which you can select the type of mathematical function you need (e.g., SUM or AVERAGE). You can also select the mathematical function by entering the name yourself (e.g., SUM or AVERAGE), followed by the cell location where you want to start the calculation, then a colon, and finally the cell location where you want to end the calculation. A colon indicates a range of cells, but if you only want to add, multiply, etc., two numbers that are not in consecutive order, you can separate the cell locations with a comma(s). The cell locations should be in parentheses. Be sure that you do NOT include spaces when you enter these items.

For example, to create a function for cell A10 that sums all of the numbers in that column you would enter this formula followed by the Enter key:

=SUM(A2:A9)

3. You can use Excel to help you with repetitive math functions, such as dividing a whole column of data by a set number to create a new column of data. If for example you want to divide all the numbers in column B by 3.5 grams:
- Add a new column for data next to column B. In the first cell of the new column (C), type the formula $=B2/3.5$. Then hit return. In this example, B2 is the cell with the first number in column B. In cell B1 you might have a name or header for the column. (see below)

	A	B	C
1	Time	CO2 produced	CO2 per gram
2		0	$=B2/3.5$
3		1	0.113
4		2	0.135
5		3	0.155
6		4	0.187
7		5	0.206

- Click on this new cell (C2) and you should see a small dark box in the lower right corner of the cell. Click and hold on this box and drag it down to all the other cells in your new column that you want filled with this calculation.
 - This new column of data may be all you want or you may use it in graphing.
4. To avoid writing formulas from scratch, click in the cell where you want the answer of your equation to appear. Go to **Formulas**. If you click on the **Insert Function** button, you will see an equal sign appear in the *fx* dialog box. You can write in your own functions here or select one from the multiple provided function button to the right. The small downward arrow will show similar function choices. You can now take your cursor and highlight the cells you wish to include in your equation. For example, if you want to add all the numbers in column B (seen above), you would double-click on SUM in the cell where you want the answer and then you would highlight all the numbers you want to include (B2 through B7). This will automatically calculate the addition of all of the numbers in column B. To execute the command, always hit the Return key.

Note: There is one special button, the AutoSum (Σ), which is on your Excel® standard toolbar. It will enter the SUM function for you and select the most likely range of cells in the current column or row that you want totaled. Be sure, however, to double-check the formula the computer is using! It cannot read your mind!!

Making Graphs and Charts**To Make a Simple Graph: (MS Excel version 15.38 Mac)**

1. When setting up your data table, **always label the columns or rows** for what the data is (e.g., time, O₂ Consumption at 25 °C, # of cells, etc.). Be sure to **Save** and name your workbook.
2. After setting up your data table, highlight the cells that you want to graph by clicking and dragging with the mouse. Be sure to highlight column headings that must be included in order for them to appear in the legend of your graph.
3. Go to the **Insert** button located under the Excel® standard toolbar between the buttons for **Home** and **Page Layout**. Clicking on that button will open up a variety of graphing options. In the middle of these choices, you will see a **Recommended Charts** button. This is a good way to preview how your data will look in a variety of graph types. You can select one of these or select the icon for the type of graph you want to the right of Recommended Charts. **Types of graphs** include bar, column, pie, line graph, XY scatter. Multiple formats will appear as icons for the type of graph you selected. Choose the one that is most appropriate. You will see a graph generated directly inside of your workbook.
4. **Once you generate the graph**, your graph will appear with **Chart Design** as the open tab above. From here you will need to check that your data is organized the way you want it on the graph.
 - A. Click on your graph so that it is highlighted. From the main menu, go to click on **Switch Row/Column**. This will change the graphing from columns of data to Rows of data.
 - B. Click on **Source Data**. A new dialog window will open titled, **Select Data Source**. Check the setting in the **Legend entries (Series)** listing. This is especially important if you have too many lines on a line graph (two lines when you should have just one). Excel® line graphs will automatically graph each column of data as its own line. You will see a small box with a listing of the **column headings for each of your columns** (if you named them in your original data chart) or you will see **Series 1, Series 2, Series 3** for unnamed columns. You can remove or add to this list. Sometimes, the X-axis values are graphed as their own line and you will want to remove it from this list. Looking at the graph diagram should help you decide which to remove and/or if you did this correctly.
 - C. Also under **Source Data**, you can change the values for your X-axis and Y-axis, if needed, by going to the appropriate box labeled either “X values” or “Y values.” These boxes are followed by a “graph” icon that you can click. Clicking this small icon will allow you to highlight the values on your data table that you would like displayed on either axis.

- D. **If you need to change the scale of either the X or Y axis**, click on the axis you want to change on the graph you have created. A **Format Axis** menu will appear. Double click on **Axis Options**. Here you can modify everything about your axis. You can select a new minimum, maximum, the scale increments, etc.
- E. **To add a title, axes, units**, Click on your graph, then click on the **Quick Layout** icon (to see a variety of preset formats) or click on the **Add Chart Elements** icon to add each element on your own. Under Add Chart Elements, you can add **Chart Title**, **Axes**, and units, move the location of your **Legend**, add a **Trendline** (and also within this display select **More trendline options** to then select **Display equation on chart** to indicate slope).

Remember you want to be sure your graph can stand on its own to fully represent your results. Be sure to write a good descriptive title and legends for your graph. Axes must be properly labeled and include units.

- F. **To add descriptive legends** if you did not include these in your original data table or graph, click on the graph to remain within the **Chart Design** tab. This will highlight the data in your data table that is included in your graph. Click on the cell above each column of data and write what you want to appear in your legend for each of these columns. Then click on the graph once more (to be within the **Chart Design** tab) and click on **Select Data**. Click on **Series 1** in the large box under **Legend entries (Series)**. To the right in the **Name** dialog box, click on the small graph insert to the right, and then click on your newly written column heading. This will enter as a formula for the column name you just added. Click back on the small graph insert. Do the same for each other Series 2, Series 3... entry you need to include in your graph legend (each column of graphed data). Once you see all your descriptive legends listed in the **Legend entries**, click **OK**. If you want to make further changes, just type these now in the column heading and hit the return key.
- G. **To change font size or style**, click in the main **Home** tab, then select a new size or font style. **To change colors within the graph**, click on the line. **Format Data Series** box will open to the right. Click on the paint bucket icon. Then select the color you want below.
- H. If you want your graph to appear as a separate document, independent of your workbook data, click on the **Move Chart** icon under the main **Chart Design** tab. You can then select "**New sheet**" and it will appear on a separate page without your data table. Note that you can get back to your data from the tabs at the bottom of the workbook. You should now have a tab for your graph as well.

Editing Your Graph

After your graph appears and your component parts are present (title, legend, axes...), you may change some of these parts by clicking directly on that component. This will call up menus that allow you to make the preferred changes. Examples include changing the font, making labels bold-type, changing the colors of the line plots on the graph, and changing the increments of the X and Y axes. Many other changes are possible. It may be helpful to try some changes and continue working with your graph until you are satisfied with its appearance.

Checklist for what your graph should include: (also refer to Appendix E for more information)

- ___ Appropriate type of graph type/format chosen.
- ___ A good descriptive title that requires no prior knowledge of the experiment.
- ___ Descriptive labels and units on both the X and Y axes (e.g., time, minutes).
- ___ X and Y axes are calibrated to fit the range of the data.
- ___ Descriptive legend if more than one data set are plotted on the graph (e.g., lines, bars, or pie chart sections).

Reminder: When your graph is just how you'd like it, save it and email it to yourself.