

# Basic Graphing in Excel

## Introduction

Beer's Law states that there is a linear relationship between concentration of a colored compound in solution and the light absorption of the solution. This fact can be used to calculate the concentration of unknown solutions, given their absorption readings. First, a series of solutions of known concentration are tested for their absorption level. Next, a scatter plot is made of this empirical data. We will use this as an example for creating a graph.

## Creating the Initial Scatter Plot

Add your data to the spreadsheet in columns. It could also be in rows but my examples will assume columns.

With the data you want graphed **highlighted**, start the chart wizard

- Choose the **Chart Wizard** icon from the tool bar (see Figure 1 for two examples). If the Chart Wizard is not visible, you can also choose **Insert > Chart...**

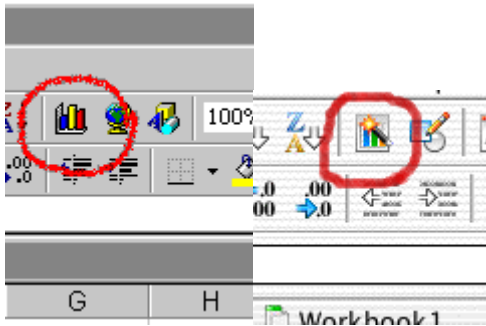


Figure 1.

The first dialogue of the wizard comes up

- Choose **XY (Scatter)** and the **unconnected points icon** for the Chart sub-type (Figure 2)

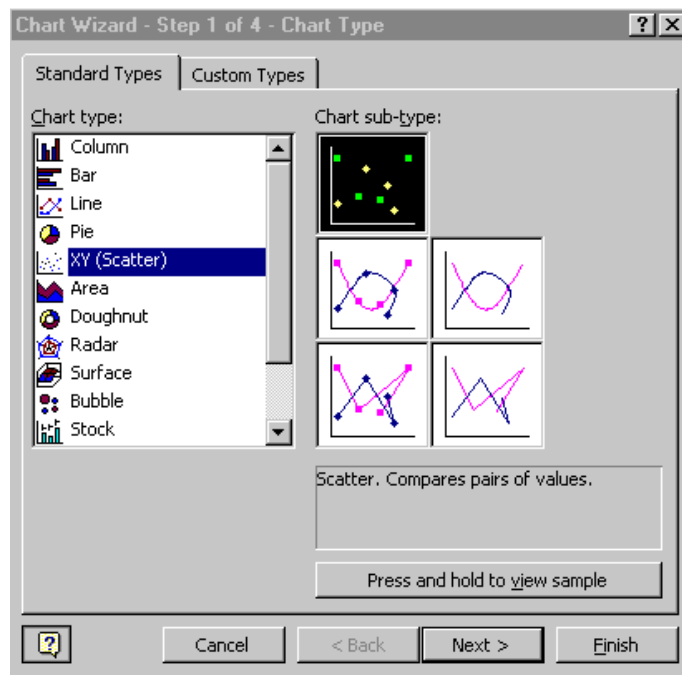


Figure 2.

- Click Next >

The Data Range box should reflect the data you highlighted in the spreadsheet. The Series option should be set to Columns, which is how your data is organized (see Figure 3).

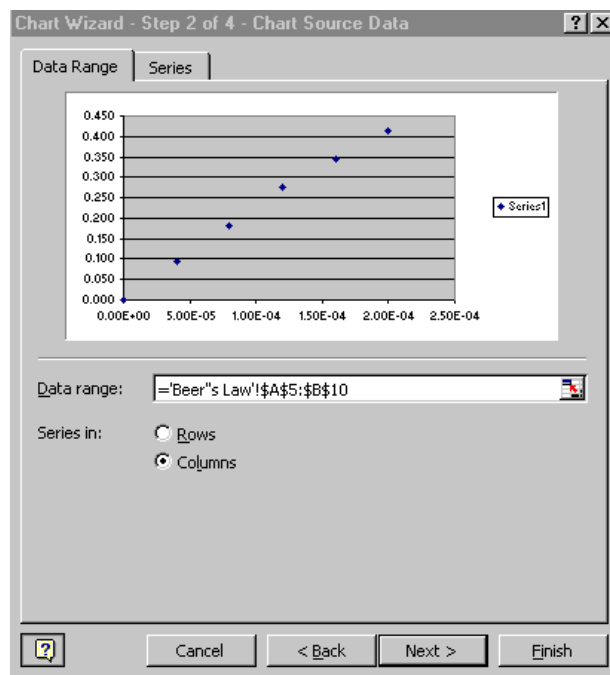
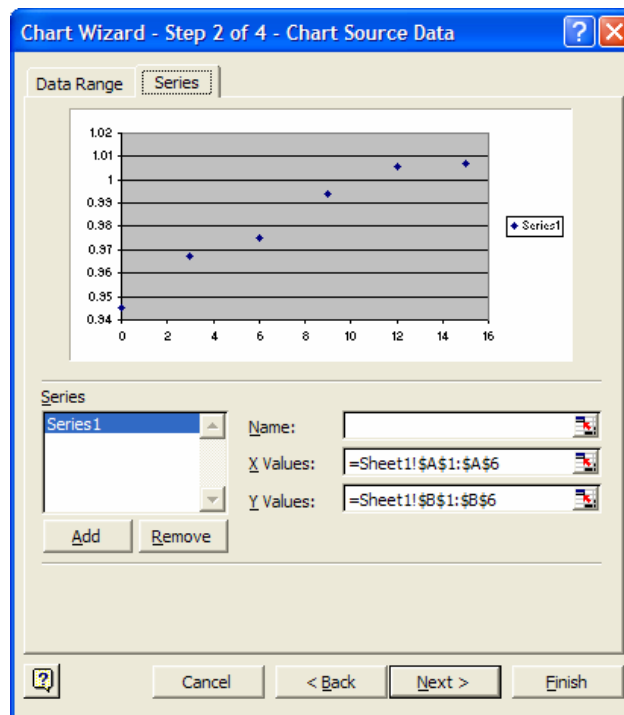


Figure 3.

If the x and y variables are reversed, you can change them by using the Series tab at the top of the box.



**Figure 4.**

Click the button next the X values, and highlight the data you would like to use as X. Do the same to select the data to use for Y values.

- Click **Next >**

The next dialogue in the wizard is where you label your chart (Figure 5)

- Enter Chart Title
- Enter a label for the Value X Axis
- Enter a label for the Value Y Axis

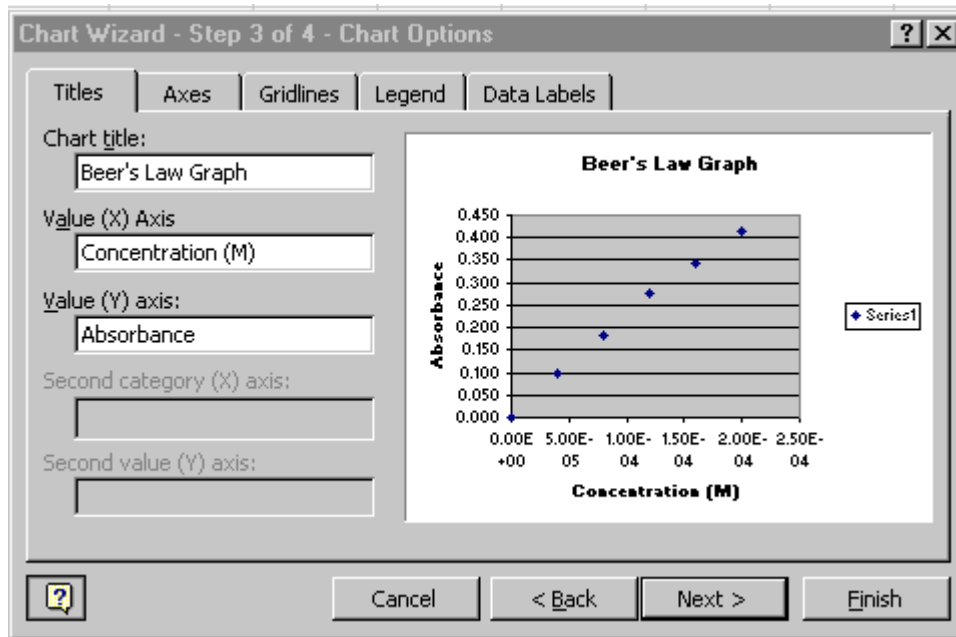


Figure 5.

- Click on the **Legend** tab
- Click **off** the **Show Legend** option (Figure 6)

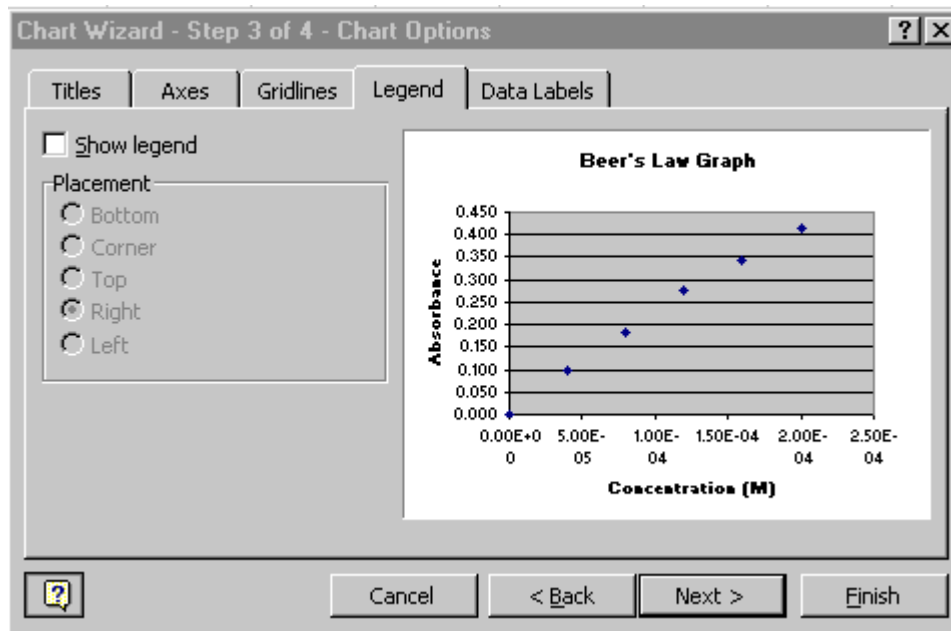
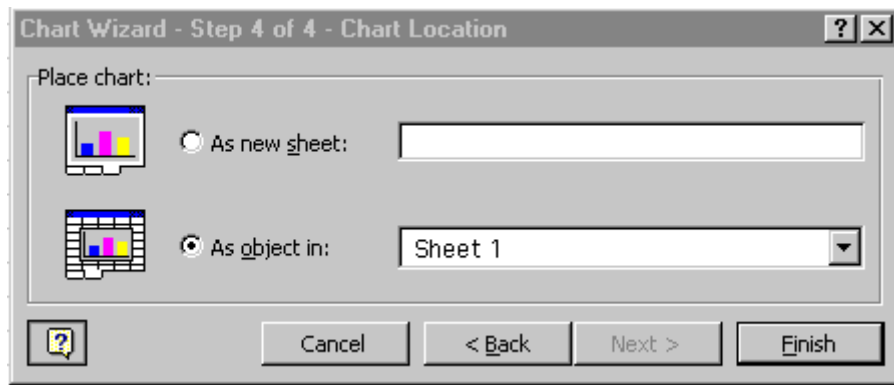


Figure 6.

- Click **Next >**

Keep the chart as **object in Sheet 1** (the current sheet). See Figure 7.



**Figure 7.**

- Click **Finish**

The initial scatter plot is now finished and should appear on the same spreadsheet page (called a sheet) as your original data. Your chart should look like Figure 8. A few items of note:

- Your data should look as though it falls along a linear path
- Horizontal reference lines were automatically placed in your chart, along with a gray background
- Your chart is highlighted with square 'handles' on the corners. When your chart is highlighted, a special Chart floating palette should also appear, as is seen in Figure 8. **Note:** If the Chart floating palette does not appear, go to **Tools>Customize...**, click on the **Toolbars** tab, and then click on the **Chart** checkbox. If it still doesn't show up as a floating palette, it may be 'docked' on one of your tool bars at the top of the Excel window.

With your graph highlighted, you can click and drag the chart to a wherever you would like it located on the spreadsheet page. Grabbing one of the four corner handles allows you to resize the graph. **Note:** the graph will automatically adjust a number of chart properties as you resize the graph, including the font size of the text in the graph. You may need to go back and alter these properties. At the end of the first part of this tutorial, you will learn how to do this.

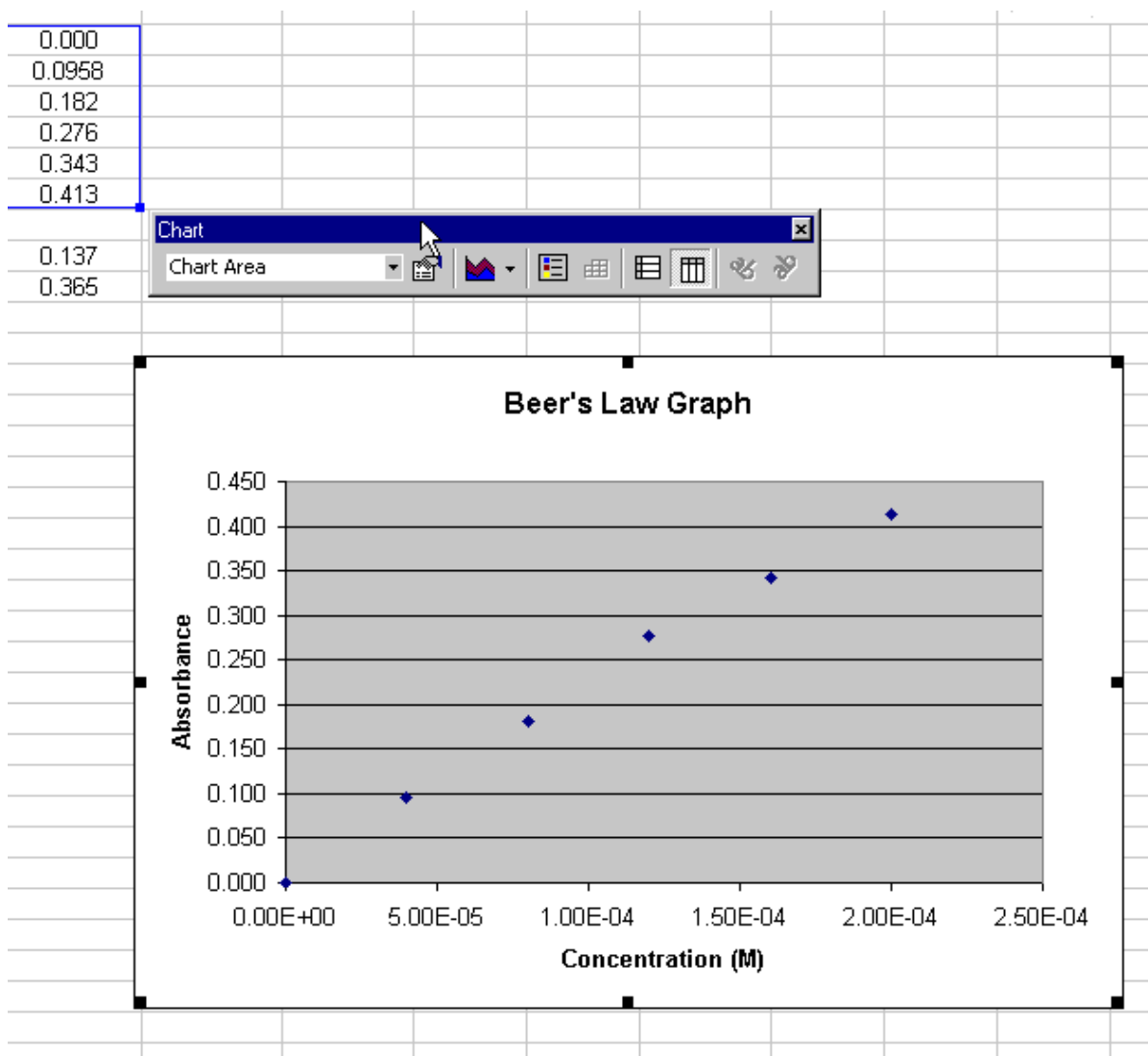


Figure 8.

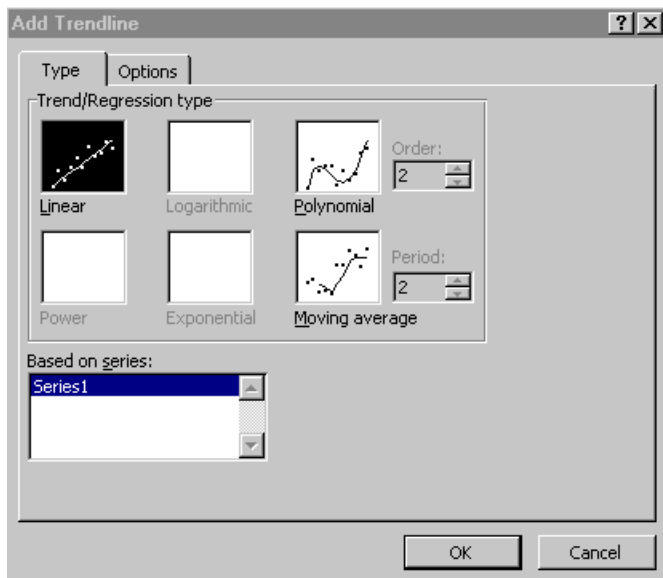
## Creating Regression (Trend) Lines

Regression lines can be used as a way of visually depicting the relationship between the independent (x) and dependent (y) variables in the graph. A straight line depicts a linear trend in the data (i.e., the equation describing the line is of first order. For example,  $y = 3x + 4$ . There are no squared or cubed variables in this equation). A curved line represents a trend described by a higher order equation (e.g.,  $y = 2x^2 + 5x - 8$ ). It is important that you are able to defend your use of either a straight or curved regression line. That is, the theory underlying your lab should indicate whether the relationship of the independent and dependent variables should be linear or non-linear.

In addition to visually depicting the trend in the data with a regression line, you can also calculate the equation of the regression line. This equation can either be seen in a dialogue box and/or shown on your graph. How well this equation describes the data (the 'fit'), is expressed as a correlation coefficient,  $R^2$  (R-squared). The closer  $R^2$  is to 1.00, the better the fit. This too can be calculated and displayed in the graph.

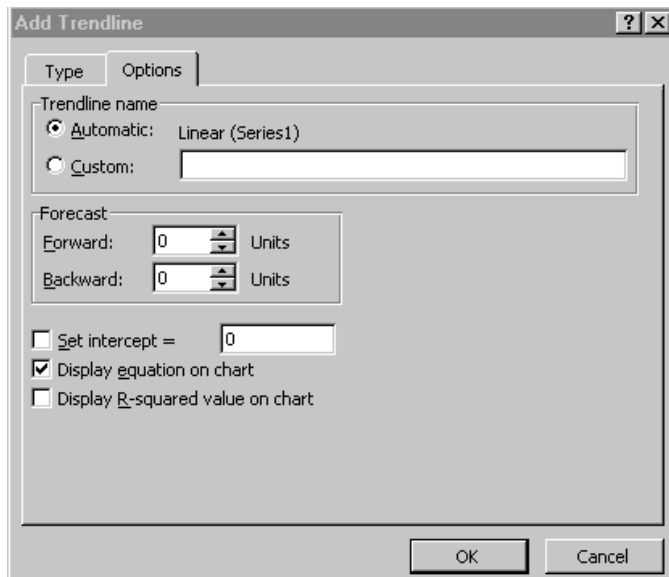
When the chart window is highlighted, you can add a regression line to the chart by choosing **Chart > Add trendline...** or by right clicking on any data point.

A dialogue box appears (Figure 9). Select the **Linear** Trend/Regression type:



**Figure 9.**

Choose the **Options** tab and select **Display equation on chart** and **Display r-squared value on chart** (Figure 10):



**Figure 10.**

Click **OK** to close the dialogue. The chart now displays the regression line and  $r^2$  value (Figure 11).

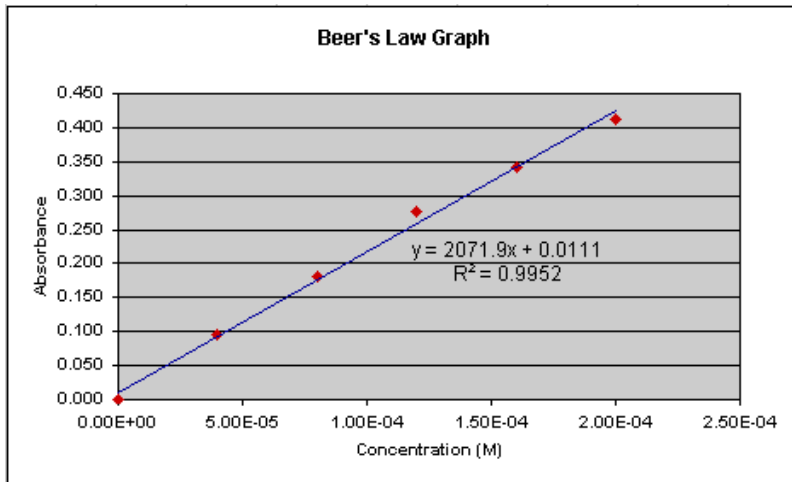


Figure 11.

### Using the R-squared coefficient calculation to estimate fit

The closer the  $R^2$  value is to 1.0, the better the fit of the regression line. That is, the closer the line passes through all of the points.

Now let's look at another set of data done for this lab (Figure 12). Notice that the equation for the regression line is different than it was in Figure 11. A different equation would calculate a different concentration for the two unknowns. Which regression line better represents the 'true' relationship between absorption and concentration? Look at how closely the regression line passes through the points in Figure 12. Does it seem to 'fit' as well as it does in Figure 11? No, and the R-squared value confirms this. It is 0.873 in Figure 12 compared to 0.995 in Figure 11. Though we would need to take into account information such as the number of data points collected to make an accurate statistical prediction as to how well the regression line represents the true relationship, we can generally say that Figure 11 represents a better representation of the relationship of absorption and concentration.

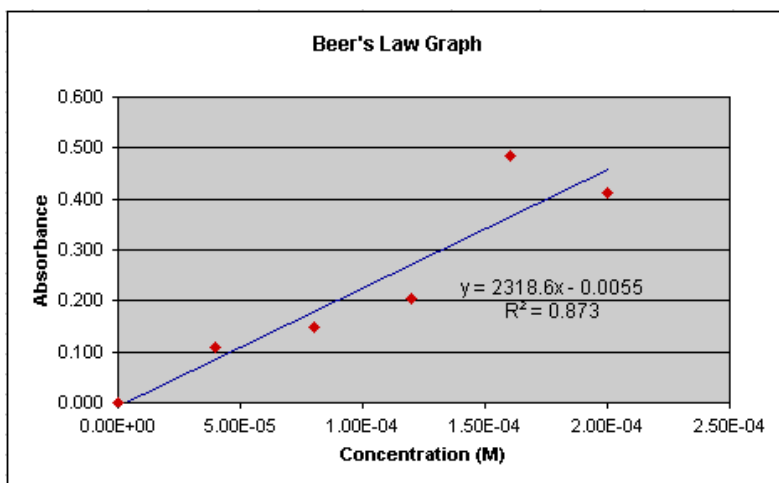


Figure 12.