Purpose

To use Excel to create and interpret graphs of experimental data.

Learning Objectives

Enter data into an Excel sheet.

Create a scatter chart in Excel.

Add axis labels and a title to an Excel chart.

Add a linear trendline and equation to an Excel chart.

Interpret data from a linear trendline on an Excel chart.

Laboratory Skills

Use a spreadsheet program

Equipment

- Computer
- Spreadsheet software (Excel, Google Sheets, etc.)

Chemicals

- none

Introduction

Graphical representation of laboratory data is often used to interpret the results of laboratory experiments. Microsoft Excel and other spreadsheet software can provide many ways to graphically represent data for a laboratory experiment. Spreadsheet software makes it easy to organize the data, to produce graphs and to carry out basic analyses of the data.

Procedure

Spreadsheet Instructions

Graphs can be prepared by hand or by computer. While you may want to do a quick sketch of your data in graphical form to get a first impression of any relationships or trends, you will want to produce your final, working graph using graphing software. General instructions are provided here that work for both Excel and Google Sheets using data provided below. Note that spreadsheet software refers to a graph as a "chart." Before you begin this lab, you should watch the Labflow video, *Excel Basics*.

Creating a Chart

1. Open the spreadsheet software.

2. Review the first minute of the Labflow video, *Excel Basics*. Enter the paired data from Table EX.1 in the spreadsheet. Be sure to label the columns with informative titles as shown in the video. Include units in the title where applicable but *not* in the same cells as the data.

Table EX.1: Practice Data

Pb level, micrograms per liter	IQ	Pb level, micrograms per liter	IQ
1	119	15	93
2	120	17	103
3	105	22	93
7	110	28	73
8	88	33	79
9	100	44	90
11	95	50	85
12	98		

3. Review the *Excel Basics* video, from timestamp 3:36 to timestamp 4:27. Insert a scatter plot and select the data for the x and y values as shown in the video. Set the Pb levels as the x values and IQ as the y values.

4. Review the *Excel Basics* video from timestamp 4:27 to timestamp 5:35 and format the chart to change the title and to add labels to both axes, following the example in the video.

5. Review the *Excel Basics* video from timestamp 6:09 to timestamp 7:01 and follow the example to fit your data to a linear trendline and to display the equation and R-squared value on the chart.

6. Double click on the equation to change the "y" and "x" to "IQ" and "(Lead Levels)" respectively.

7. If needed, this page of the workbook can be printed; both the data and the graph will be on one page. Alternatively, by clicking on the graph and then printing, you will obtain a full page chart.

Analyzing a Data Set

8. To solidify your graphing skills, you will be given your own set of data on Labflow and use graphing software to complete the worksheet for the data set.

9. Use Equation EX.1 to determine the percent error for your data set.

$$\%\ \text{error} = \left|\frac{\text{Actual} - \text{Experimental}}{\text{Actual}}\right| \times 100 \qquad \text{(Equation EX.1)}$$

Graphing Data Set

Pi (π) is the ratio of the circumference of a circle to its diameter, shown in Figure EX.1. The value of this ratio is a constant regardless of the size of the circle; thus pi is a universal physical constant. The diameter and circumference of several circles were measured by chemistry students, each using a different ruler. You should view your data set in the Report on Labflow.

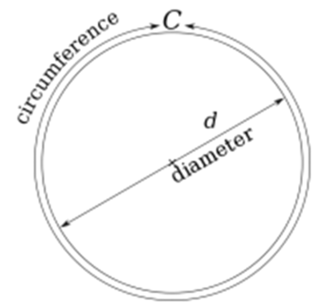

Figure EX.1: Diameter and circumference of a circle

1. Inspect the data in the Report on Labflow and calculate the value of pi using two pairs of the data. ________________ ________________

2. Prepare a hand-drawn plot of the two variables using the grid sheet at the end of the document or other graph paper.

   a. Include a title, axis labels with the *x*-axis having a label of "Diameter (cm)" and the *y*-axis having a label of "Circumference (cm)." Finally, include a trendline.
   b. Estimate the circumference of a circle with a diameter of 4.50 cm: ________________
   c. Estimate the diameter of a circle with a circumference of 3.94 inches: ________________
   d. Submit a copy of this graph.

3. Prepare a plot using graphing software.

   a. Include a title, axis labels (with units) as before, the equation of the best-fit line, and the R^2 value on the graph.
   b. Re-write the equation of the best-fit line substituting "Diameter" for x and "Circumference" for y directly on the graph.
   c. Submit a copy of the fully labeled graph.

4. What is the value of pi based on the equation for the best-fit line? ________________

5. Determine the percent error using Equation EX.1 and an actual value of 3.142 for pi.

   % Error = ________________

6. Using your computer-generated graph,

   a. visually estimate the circumference of a circle when the diameter is 4.50 cm: ________________

b. calculate the circumference for d = 4.50 cm using the equation of the best-fit line: ________________. Use the graph to ensure that this value is reasonable.

c. compare the calculated circumference to the two visually interpolated values (Steps 2b and 6a). Briefly discuss any discrepancies.

7. Using your computer-generated graph,

   a. visually estimate the diameter of a circle with a circumference of 3.94 inches: ________________

   b. calculate the diameter using the equation of the line: ________________. Use the graph to ensure that this value is reasonable.

   c. compare the calculated diameter to the two visually interpolated values (Steps 2c and 7a). Briefly discuss any discrepancies.