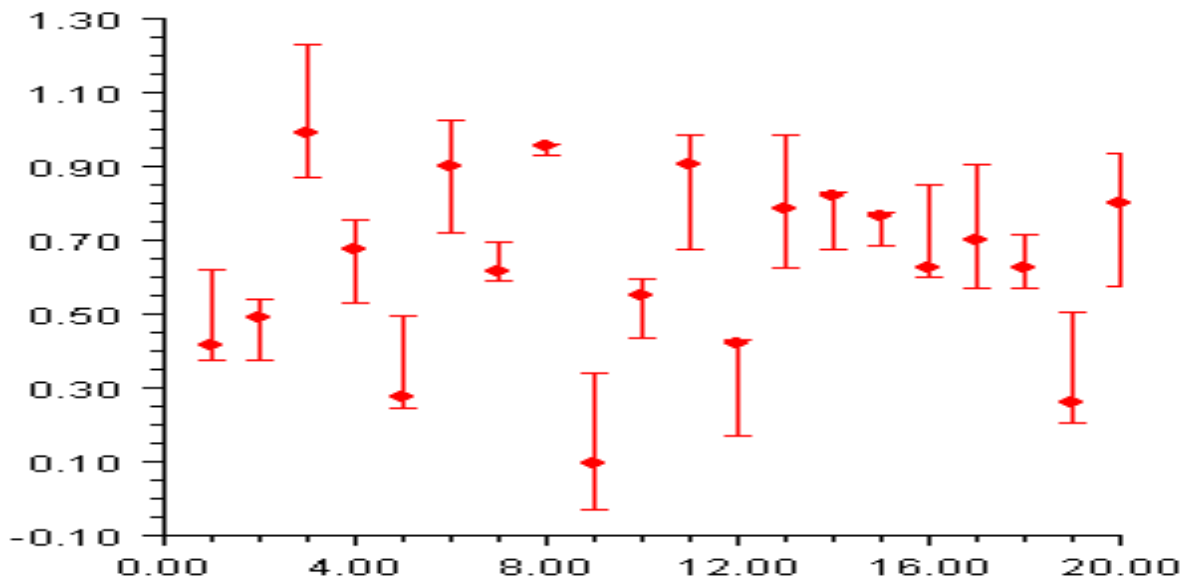


Moon Phases & Global Temperatures Lab

Background: In this lab, you will plot a graph showing the relationship between moon phase and global temperature. You will also show the statistical errors for each measurement by the use of error bars. Measurements are never exact and the data in this activity reflects this by giving an error for each measurement.

Error bars are used to indicate an estimated error in a measurement and graphically show the range over which the actual value is expected to be found, given the measured value. The most common error bar plot is one in which the errors are in the y-values. The example below shows such an error bar plot. Note that the values of the low and high arguments are absolute y-values, not relative or percentage values. **Note:** it is possible to have horizontal error bars, indicating errors in x-values; and error bars that indicate errors in both x and y values.

Error Bar Sample



The following *Temperature Anomaly Data Table* was created from many years of temperature data. The first column, “*Moon Phase*” varies from 0.0 (new moon) to 1.0 (full moon), reflecting the fraction of the moon that is lit by the sun. In the second column, “*Global Temperature Anomaly*” lists the difference in night-time temperature from the night-time global average. Finally, the third column of the data table, “*Temperature Anomaly Errors*” gives the error for each temperature measurement. This error represents the range above and below the given measured value of the global temperature anomaly, within which the actual value is expected to fall.

Materials:

- ruler
- graph paper

Data

Temperature Anomaly Data Table		
Moon Phase	Global Temperature Anomaly (°C)	Temperature Anomaly Errors (°C)
0.013	-0.014	±0.003
0.037	-0.024	±0.005
0.075	-0.018	±0.004
0.150	-0.010	±0.003
0.250	-0.010	±0.004
0.350	-0.012	±0.004
0.450	-0.014	±0.004
0.550	-0.004	±0.004
0.650	-0.009	±0.004
0.750	-0.013	±0.004
0.850	-0.007	±0.005
0.925	-0.010	±0.005
0.963	-0.001	±0.005
0.987	0.000	±0.005

Procedure:

- For the graph, you are plotting *Global Temperature Anomaly* (in degrees Celsius) along the y-axis and *Moon Phase* along the x-axis (from 0.0 to 1.0 where 0.0 represents the new moon and 1.0 represents the full moon.) Below is a sample of the graph layout.

-0.026									
-0.028									
-0.030									
	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200

Note: *Moon Phase* (x-axis) only goes to 0.200 in the graph above (it must go to 1.000) and the *Global Temperature Anomaly* only goes to -0.026 (it must go to 0.010.) Remember to label the graph completely (i.e. axis labels; graph title.)

- After plotting the points, use the “Error Bar Sample” on the previous page as a guide to draw error bars for each data point. Each error bar should extend vertically up or down from the data point according to the degree difference

given in the data table. The top and bottom of each error bar should be denoted by a horizontal dash at the end of each range.

- Use the ruler to draw a "best-fit" line through the data. A best-fit line on a graph with error bars should pass through most of the data point ranges; but does not necessarily pass through all of the data point ranges.

Analysis & Conclusion Questions:

1. How do error bars help you decide how to place a best-fit line? How do error bars help you determine the accuracy of a best-fit line?
2. Using your best-fit line, extrapolate (estimate) to find the temperature anomaly at the new moon phase and the full moon phase.
3. Are global temperatures warmer at full moon than they are at a new moon? Hypothesize an explanation for your answer.
4. Calculate the difference between the two values you determined in the answer to question two (2.) Could you detect this temperature difference using the thermometers you use in school? Explain.