

CBL Activity – Lights On and Off!

Objective

Math Concepts: periodic functions, graphing and interpreting graphs

Science Concepts: data collection and analysis, period and frequency

Materials

CBL 2, TI Graphing Calculator, link-to-link cable, TI light sensor, 1 non-fluorescent light source

Introduction

A rocking chair moving back and forth, a ringing telephone, and water dripping from a leaky faucet are all examples of periodic phenomena. They are called periodic because they are like rhythmic cycles that occur at regular time intervals. The time required to complete one cycle of the behavior is called the period. The number of cycles per unit time is known as the frequency.

In the following activity, you will use the CBL2 and a light-sensor to collect data for two different types of periodic phenomena. You will then analyze this data with your calculator to find the period and the frequency of the observation

Activity

You will point a light sensor towards a light source such as a window, bright bulb or an overhead lamp. To begin, the end of your sensor will be covered by your thumb. When the CBL is activated, you will begin alternately lifting your thumb from the sensor and re-covering it. Light intensity readings will be collected by your CBL and then displayed as a graph on the screen of your calculator. Follow the step below to collect the data

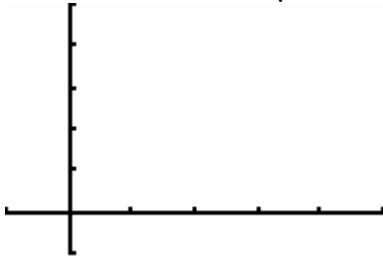
1. Set up the experiment by connecting the CBL 2 to the calculator. Then connect the light sensor into Channel 1. Then run the DataMate application.
2. Hold the light sensor inside your fist with the end of the sensor protruding about $\frac{1}{2}$ inch. The end of the sensor must be pointed towards a light source.
3. The top right corner of the DataMate screen shows the light intensity readings from the light sensor as it is covered and uncovered.
4. Your data should show intensity levels which start at a large value then alternate between this value and a value close to zero in a regular pattern. The time interval between cycles should appear to be relatively constant.

Analysis

If your data is satisfactory, sketch a plot of your data on the axes on the Data Reporting Sheet.

Data Reporting Sheet

1. Make a sketch of your data. Label the axes.



For the data above, what do the plateaus represent? What do the minimum values represent?

2. Press right or left arrow to move the cursor along the plot. The x-values shown at the bottom of your calculator screen are times and the y-values are intensities. Trace to the first time value corresponding to zero intensity following the initial plateau. Record this time value below, rounding to the nearest hundredth of a second.

A = _____ seconds

3. Use the arrow keys to move to the first time value corresponding to zero intensity following the last complete plateau shown on the screen. Record this time value below, rounding to the nearest hundredth of a second.

B = _____ seconds

4. How many cycles were completed between time A and time B? That is, how many times did you uncover then re-cover the sensor during this time interval? Record this number below:

C = _____

5. The period is the time required to complete one cycle. Subtract A from B and then divide by C, to find the average time period. Record this value below:

Period: _____ seconds

6. While the period represents the number of seconds per cycle, the frequency is the number of cycles per second. Find the frequency of the cover-uncover motion by taking the reciprocal of the period value you just found. Record this value below.

Frequency: _____ cycles per second