Swing Thing

Student Activity

Name ________________

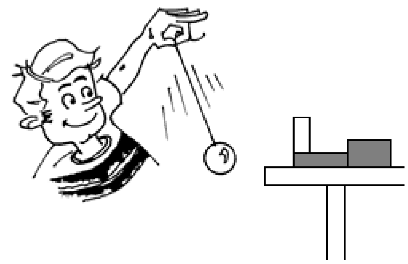
Class ________________

Introduction

When you swing back and forth on a playground swing, you're modeling the motion of a simple pendulum. What affects the way a pendulum swings? Its length? How far it is pulled back before you release it? The weight of the object hanging from it? When the important characteristics of a pendulum are identified, you can use math to make predictions about its motion.

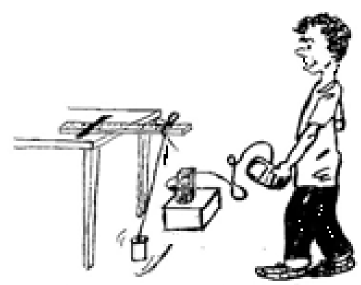
Objectives

- Construct a pendulum.
- Use a distance-time plot to measure the period of the pendulum.
- Describe the effects that different characteristics have on the period of a pendulum.



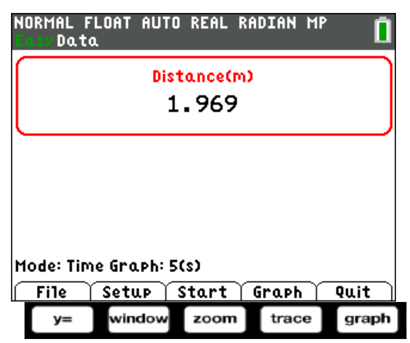
You'll Need

- TI 84 Plus CE, with Vernier EasyData™ App
- CBR 2™ motion sensor unit with mini-USB connecting cable
- Meter stick and ruler
- String, a little more than a meter long
- Scissors
- Empty aluminum soda can (with pull-tab still intact)
- Water
- Measuring cup or 50 ml graduated cylinder



Using the CBR 2™ motion sensor and Vernier EasyData™ App

Connect the handheld with the CBR 2 using the USB cable. EasyData will immediately open, and the CBR 2 will begin collecting distance data every time it clicks. In the EasyData app, the tabs at the bottom indicate the menus that can be accessed by pressing the actual calculator keys directly below the tabs.



Collecting the Data

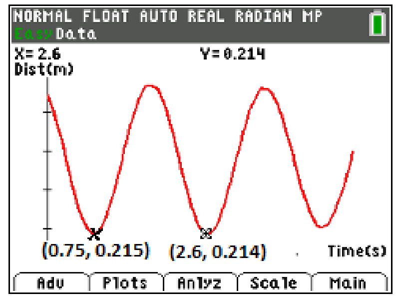
1. Tie one end of the string to an empty aluminum can with pull-tab. With the meterstick, find the place on the string at 30 cm. Hold or tie the string at this point so that the pendulum string is 30 cm long.

2. Position the CBR 2 and the pendulum so that when the pendulum swings, the can stays in front of the sensor and not closer than about 15 cm (6 inches). When you are ready, select Start by pressing zoom. If you get a message, “The selected function will overwrite the latest run,” select OK by pressing graph.

3. If you are satisfied with your graph, use the arrow keys ◀▶ to find the time (x-coordinate) of two consecutive peaks or two consecutive valleys. When you subtract the values, you have the time for one cycle (period). An example is shown. Record your period below.

_____________ – ___________ = ________________

Second peak (valley)   First peak (valley)   Period of Pendulum



Period = 2.6 – 0.75 = 1.85 sec.

Looking at the Results

1. What are two factors do think you can change about the pendulum that would change the period?

2. Predict how the period will change when you increase each factor.

When _________________ is increased, the period will __________________________.

When _________________ is increased, the period will __________________________.

3. Investigate the first factor (variable) and record the data in the table.

		Period (sec.)
30 cm string	Empty can	

4. Investigate the second factor (variable) and record the data in the table.

		Period (sec.)
30 cm string	Empty can	

5. Summarize your findings by describing what happens to the period of the pendulum when you increase each factor.

Going Further

1. Which factor changed the period the most? If you cut that variable in half, did the period get cut in half? What does this tell you about the relationship between the variable and the period?

2. The frequency of a swinging pendulum tells how many cycles it completes per second. Frequency and period are related by the formula:

$$\textit{Frequency} = \frac{1}{Period}$$

Using the data you collected, find the frequencies for two of the pendulums that you made.

3. How would frequency change if a pendulum's period is tripled? Be specific.

4. Complete this sentence: When the ________________ of a pendulum is increased, the frequency of the pendulum _________________________.

