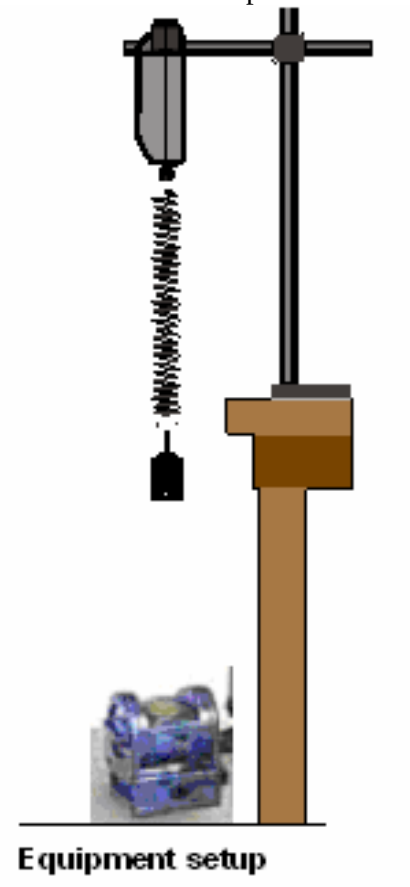
Oscillations on a Spring Investigation

Purpose:
The purpose of this lab is to investigate the periodic motion of a mass oscillating on a spring. The purpose of this lab is for you to develop a qualitative and conceptual understanding of this type of periodic motion.

Experimental Set-up:
You will be using a long spring hung from a force sensor as shown in the illustration below. Place a motion detector on the floor below the spring aimed upward. Unlike the illustration the supporting rods should be clamped to the table.



Equipment setup

Attach the sensors to your GLX interface and open a new DataStudio file with the appropriate graphs to collect your data (see data collection to determine which graphs that will be).

Data Collection:
Part A – Spring Constant
In order to analyze the periodic motion of the mass on the spring it is first necessary to determine the spring constant (k) for your particular spring. Devise a procedure using at least 4 different masses to determine the spring constant for your spring. Using Excel, plot a graph that will allow you to determine the spring constant (k) for your spring. (hint: think about the variables!) ***For the report, provide a description of the procedure used for determining the spring constant for the spring.***

Print a copy of your Excel graph, and explain how you got k from the graph. Also, include a simple data table showing the data you plotted.

Part B – Time for the Oscillations

For these oscillation experiments, always displace the mass down, towards the position sensor, to prevent large displacements from causing masses to crash into the position sensor. Hang a mass from the spring, let it reach its equilibrium position, and then displace it down from its equilibrium position (pull it down a little). Measure the displacement. Run a test to make sure that the spring oscillates with a smooth motion and doesn't bunch up when it recoils. Release the mass from rest, and after a couple of oscillations (a complete up and down motion), begin data collection. Record the motion of the mass on the spring for about 15-20 oscillations.

From the Data Studio graphs determine the average period for one oscillation. Use several time intervals consisting of more than one oscillation to determine this average. ***Record the information you used to determine the average period in a data table, and include it in your report.***

The trial you just completed will serve as your baseline for the next set of comparisons. Repeat it to verify that the average period stays the same (estimate a value for experimental uncertainty in the period).

Test several different hanging masses and determine whether the mass influences the period of the oscillation (remember to control all other variables). ***Record your data in a data table, and make a plot using Excel of the period vs. the hanging mass. Discuss how you came to your conclusion of whether or not the mass affects the period. Remember to use your data as evidence, and to discuss what it means!***

Next test whether or not the initial displacement when released from rest (the amplitude of the motion) has an effect on the period of the oscillation (remember to control all other variables). ***Record your data in a data table, and discuss how you came to your conclusion of whether or not the amplitude affects the period. Remember to use your data as evidence, and to discuss what it means!***

Run one last trial to generate simultaneous position vs. time, and velocity vs. time, and force vs. time graphs for the oscillating mass. Discuss the phase relationship (look up what is meant by phase relationship) between the data represented on the three graphs (print copies of the graphs for your report).