

Lab 6 - Introduction to Motion: Distance and Time Measurements Using a Motion Sensor

Name _____

Partner's Name _____

I. Introduction/Theory

The purpose of this activity is to introduce the relationships between the motion of an Object and a Graph of position and time for the moving object.

NOTE: This activity is easier to do if you have a partner to run the computer while you move or vice versa.

When describing the motion of an object, knowing where it is relative to a reference point, how fast and in what direction it is moving, and how it is accelerating (changing its rate of motion) is essential. A sonar ranging device such as the Motion Sensor uses pulses of ultrasound that reflect from an object to determine the position of the object. As the object moves, the change in its position is measured many times each second. The change in position from moment to moment is expressed as a velocity (meters per second). The change in velocity from moment to moment is expressed as an acceleration (meters per second per second). The position of an object at a particular time can be plotted on a graph. You can also graph the velocity and acceleration of the object versus time. A graph is a mathematical picture of the motion of an object. For this reason, it is important to understand how to interpret a graph of position, velocity, or acceleration versus time. In this activity you will plot a graph in real-time, that is, as the motion is happening.

II. Equipment

Computer

Science Workshop™ Interface

base and support rod

motion sensor

air track

III. Procedure

For this activity, you will be the object in motion. The Motion Sensor will measure your position as you move in a straight line at different speeds. The *Science Workshop* program will plot your motion on a graph of position and time. The challenge in this activity is to move in such a way that a plot of your motion on the same graph will “match” the line that is already there.

PART 1: Computer Setup

- Verify/Connect the motion sensor's stereo phone plugs to Digital Channels 1 and 2 on the interface. Connect the yellow-taped plug to Digital Channel 1 and the other plug to Digital Channel 2.
- Verify/Connect the *Science Workshop* interface to the computer, turn on the interface, and then turn on the computer.
- Open the *Science Workshop* file titled as shown:

Macintosh: P01 Understanding Motion 1

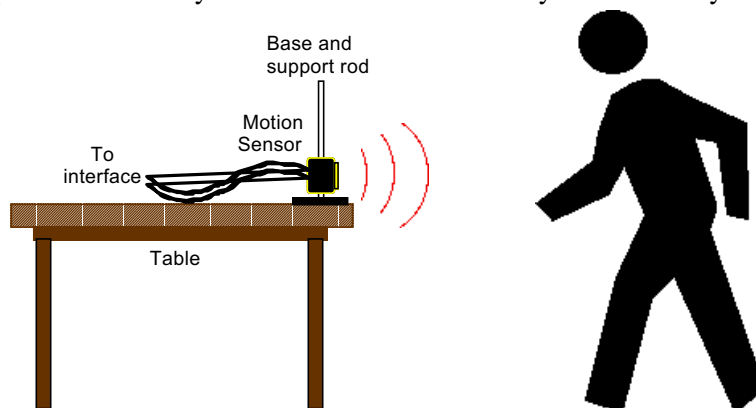
<Macintosh HD>, <Science Workshop folder>, <Science Workshop>

File: open: Macintosh HD/Experimental Library folder/Physics/P01 Understanding Motion I exp.

- The document has a Graph display of Position (m) and Time (sec). The Graph shows Position and Time values that were put into the Graph using the “Load Data...” feature (see the User’s Guide for *Science Workshop*).
- (Note: For quick reference, see the Experiment Notes window. To bring a display to the top, click on its window or select the name of the display from the list at the end of the Display menu. Change the Experiment Setup window by clicking on the “Zoom” box or the Restore button in the upper right hand corner of that window.)
- D. The "Sampling Options..." for this experiment are as follows: Periodic Samples = Fast at 10 Hz, Digital Timing = 10000 Hz, and Stop Condition with Time = 10.00 seconds.

PART 2: Sensor Calibration and Equipment Setup

- You do not need to calibrate the motion sensor.
 - A. Verify/Mount the motion sensor on a support rod so that it is aimed at your midsection when you are standing in front of the sensor. Make sure that you can move at least 2 meters away from the motion sensor.
- NOTE: You will be moving backwards for part of this activity. Clear the area behind you for at least 2 meters (about 6 feet).
- B. Position the computer monitor so you can see the screen while you move away from the motion sensor.



Understanding Motion 1: Position and Time

PART 3: Data Recording

- A. Click on the Graph to make it active. Enlarge the Graph until it fills the monitor screen.
- B. Study the Position versus Time plot in order to determine the following:
 - How close should you be to the motion sensor at the beginning? _____ (m)
 - How far away should you move? _____ (m)
 - How long should your motion last? _____ (sec)
- C. When you are ready, stand in front of the motion sensor. WARNING: You will be moving backward, so be certain that the area behind you is free of obstacles.
- D. Click the “REC” button to begin recording data. (Data recording will begin almost immediately. The motion sensor will make a faint clicking noise.)
- E. Watch the plot of your motion on the Graph, and try to move so that the plot of your motion matches the Position vs Time plot that is already there.
 - Data recording will end automatically after a certain amount of time, or click on “STOP” to end sooner. Run #1 will appear in the Data list in the Experiment Setup window.
- F. Repeat the data recording process a second and a third time. Try to improve the match between the plot of your motion and the plot that is already on the Graph.

