# TechLab: Sonic Ranger
computer-assisted real-time position graphing
USE PENCIL ON LABS!
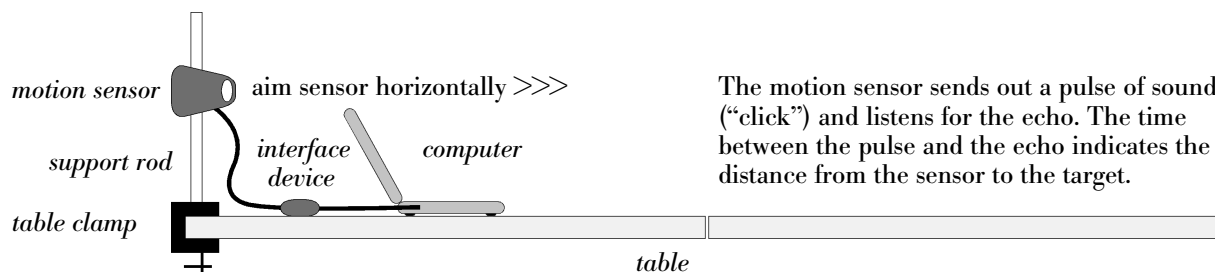
| | | | 1 |
|---|---|---|---|
| ☐ | | | 2 |
| ☐ | | | 3 |
| ☐ | | | 4 |

## • Purpose •
In this activity, you will investigate motion through graphs of position *vs.* time *of your own motion drawn in real time.*

## • Apparatus •

___computer ___interface device ___motion sensor ___sensor software
___table ___table clamp ___support rod ` (Match Graph or eq.)



*motion sensor* aim sensor horizontally >>>

*support rod*    *interface device*    *computer*

*table clamp*

*table*

The motion sensor sends out a pulse of sound ("click") and listens for the echo. The time between the pulse and the echo indicates the distance from the sensor to the target.

**NOTE: This activity involves the use of the computer and sensor(s). These items are very expensive and fragile. Extreme care must be taken at all times when transporting and using the computer and the sensors. Attention to the safety and security of the computers and sensors throughout the classroom (and awareness of the location of all connecting wires) must be paid at all times.**

## • Setup • *It is important that you follow the order of these instructions exactly!*
1. Use the diagrams above as a guide. Attach the table clamp to the table. Attach the support rod to the table clamp.

2. Attach the motion sensor to the support rod at a height of about 4 feet. Aim it as shown in the diagrams above. If available, switch the sensor to "people" or "long range" mode (as opposed to "cart" or "short range" mode). Connect the motion sensor to the interface device. (Keep excess lengths connecting wire on the table instead of letting it dangle onto the floor.)

3. Start the computer. Wait for it to complete its start-up cycle. Don't click on anything on the desktop.

4. Connect the interface device to the computer. (The USB Link connects to the USB port on the computer.)

## • Probeware Activation •
1. Select "**Match Graph"** from the dock. When Match Graph opens, it might complain that it can't find the sensor. If you're sure your sensor is plugged in, click the X in the complaining dialog box and proceed.

2. Click the application window's "green dot" to maximize. **Click the on-screen 4-symbol-button (top center) then choose the non-pattern, simple axes (Choice 10).**

3. Activate the sensor by clicking on the red "Record" button located at the top center of the screen. The sensor should start clicking, and a count down "second-sweep" should appear.

4. Allow each member of the group to experiment with the motion sensor. Stand in front of it. Move toward it and away from it. Stand still. Reset the graph by clicking on the stop/start button each time you wish to clear the graph (between each member's turn with the sensor, for example). Make sure you have at least two meters to move in, and that the walking space is clear of chairs, wires, and other obstacles. As shown in the diagram above, **the person walking in front of the sensor is the person watching the computer screen.**
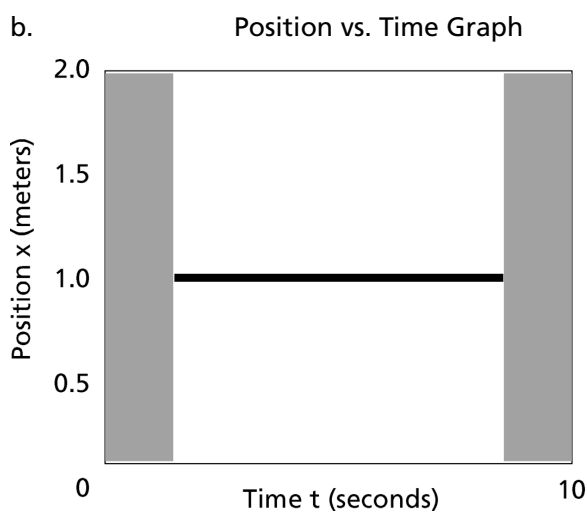
## • Procedure •

1. MOVING PICTURES

Generate real time graphs of each motion depicted below and write a verbal description of each. **Do not use any form of the word "accelerate" in your descriptions.** Use terms and phrases such as, "rest," "constant speed," "speed up," "slow down," "toward the sensor," and "away from the sensor."
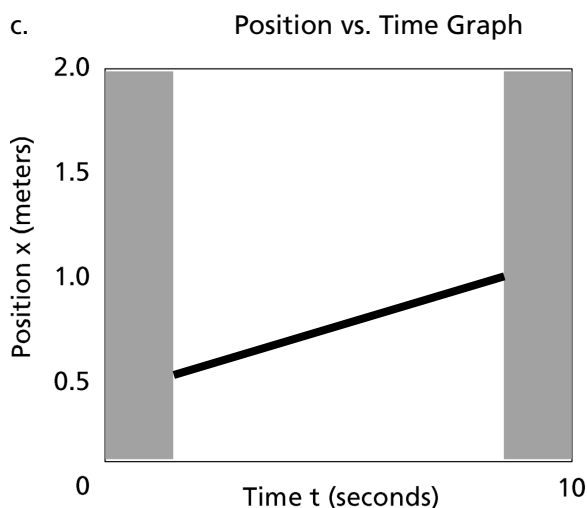
a.

**Position vs. Time Graph**

Position x (meters) vs. Time t (seconds)
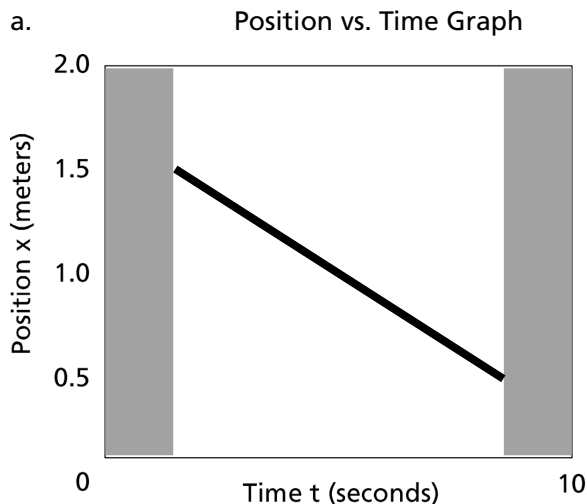
**Verbal Description of Motion**

*Move toward the sensor at constant speed.*

*Make sure everyone in the group can actually do this BEFORE moving on to the next procedure!*
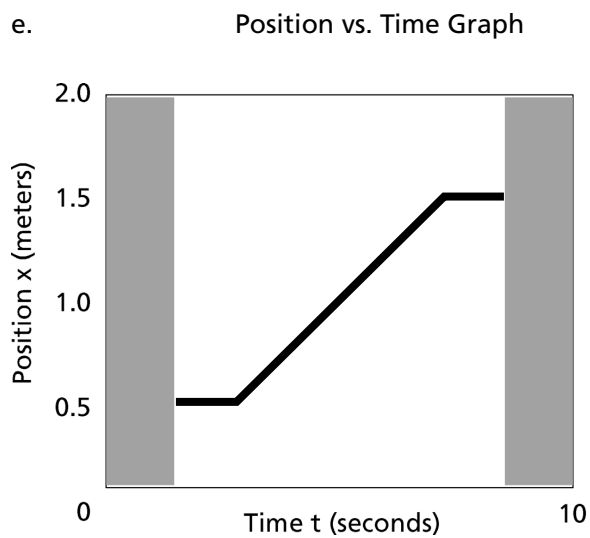
b.

**Position vs. Time Graph**

Position x (meters) vs. Time t (seconds)

**Verbal Description of Motion**

c.

**Position vs. Time Graph**

Position x (meters) vs. Time t (seconds)

**Verbal Description of Motion**

db

**d.**

### Position vs. Time Graph

Position x (meters) vs. Time t (seconds)
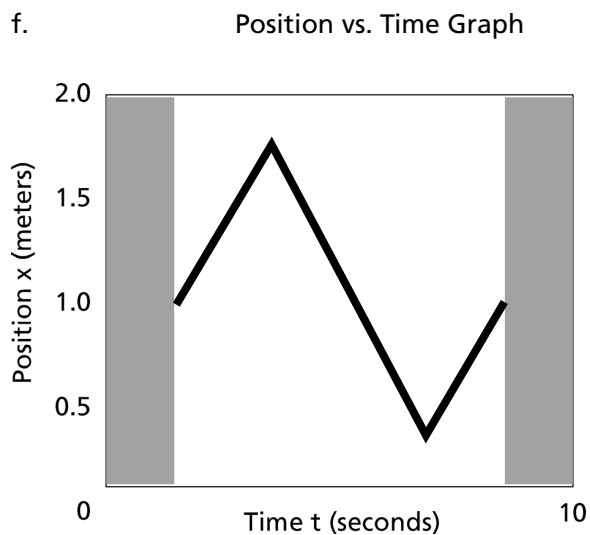
2.0
1.5
1.0
0.5

0     Time t (seconds)     10
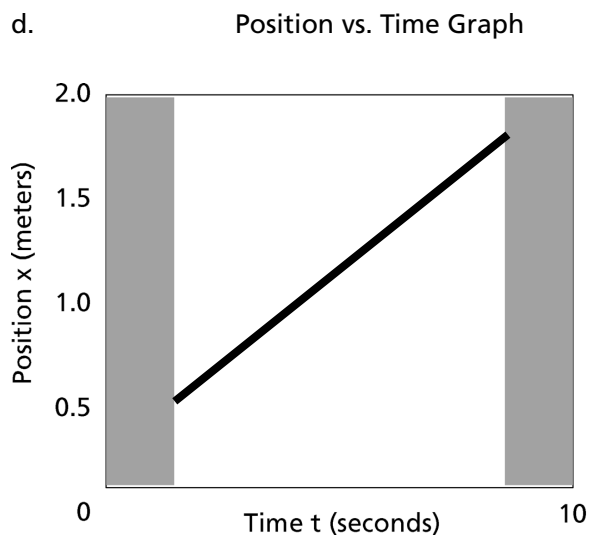
### Verbal Description of Motion

• How is this motion similar to motion c?

• How is this motion different from motion c?

**e.**

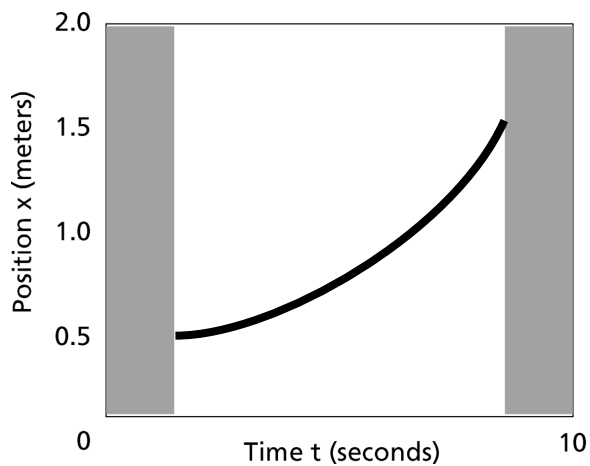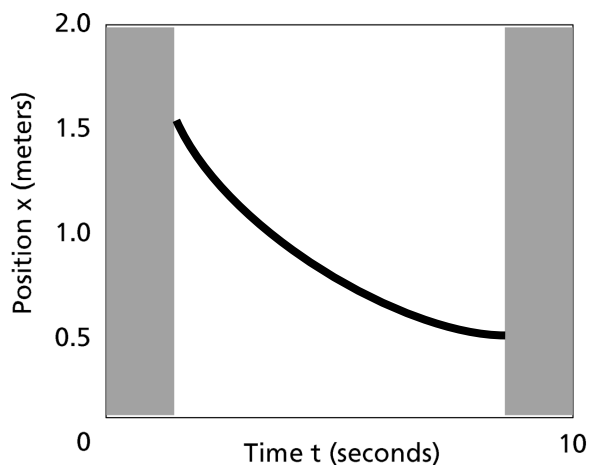### Position vs. Time Graph

Position x (meters) vs. Time t (seconds)

2.0
1.5
1.0
0.5

0     Time t (seconds)     10

### Verbal Description of Motion

**f.**

### Position vs. Time Graph

Position x (meters) vs. Time t (seconds)

2.0
1.5
1.0
0.5

0     Time t (seconds)     10

### Verbal Description of Motion

db

**g.**   Position vs. Time Graph                    Verbal Description of Motion



Position x (meters)

2.0

1.5

1.0

0.5

0          Time t (seconds)          10


**h.**   Position vs. Time Graph                    Verbal Description of Motion



Position x (meters)

2.0

1.5

1.0

0.5

0          Time t (seconds)          10


**i.**   Position vs. Time Graph                    Verbal Description of Motion



Position x (meters)

2.0

1.5

1.0

0.5

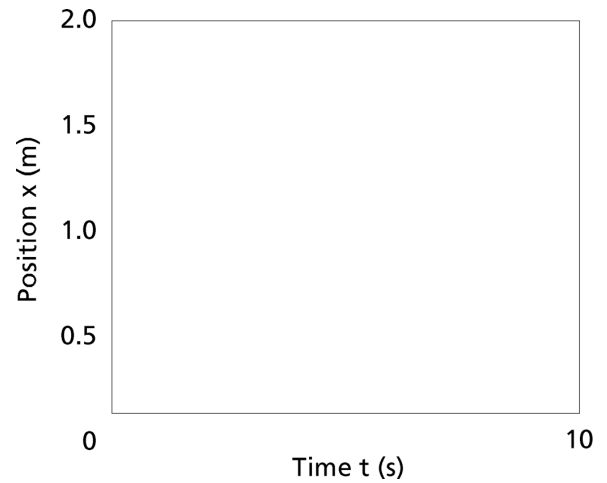0          Time t (seconds)          10

db

2. WORDS INTO ACTION

Walk the motion described below with the motion sensor activated. Draw the resulting position graph.

a.           Verbal Description of Motion                              Position vs. Time Graph

**Move toward the sensor at constant speed, stop for a few seconds, then walk away from the sensor with constant speed.**

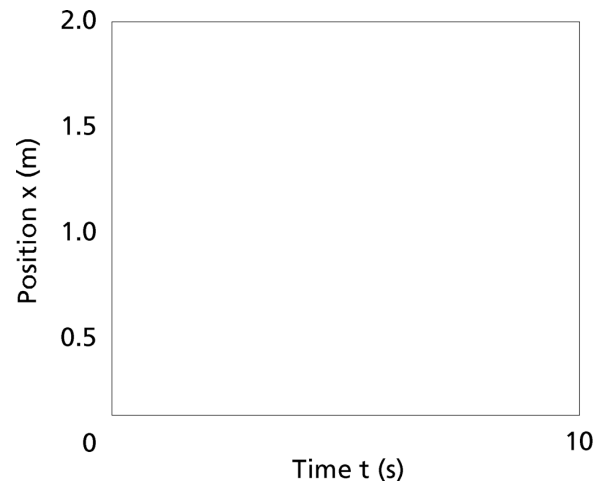Position x (m)

2.0

1.5

1.0

0.5

0                                                    10

Time t (s)

b.           Verbal Description of Motion                              Position vs. Time Graph

**Move toward the sensor with decreasing speed, then just as you come to rest, move away from the detector with increasing speed.**
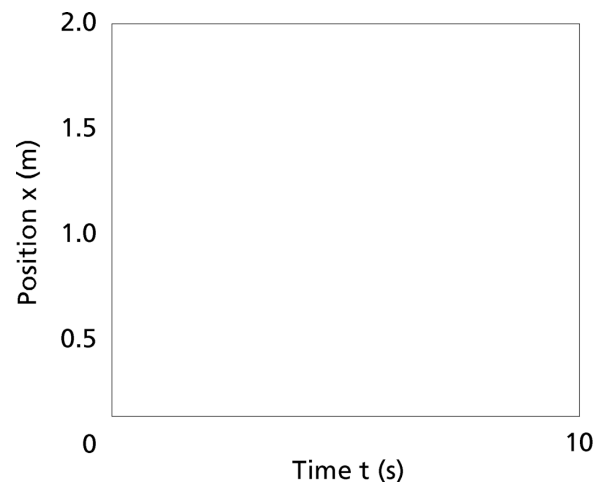
Position x (m)

2.0

1.5

1.0

0.5

0                                                    10

Time t (s)

c.           Verbal Description of Motion                              Position vs. Time Graph

**Move away from the sensor with decreasing speed until you come to a stop. Then move toward the sensor with decreasing speed until you come to a stop.**

**This one is possible but tricky; take your time to be sure of your answer!**

Position x (m)

2.0

1.5

1.0

0.5

0                                                    10

Time t (s)

3. TOE THE LINE

Now that you've mastered the fine art of generating position vs. time graphs, try matching the computer's built-in, pre-drawn "assessment" graphs.

a. Click the 4-symbol button and choose pattern 5. A pre-drawn graph (resembling graph 1.e. above) should appear on the screen. Click the start button and see how well you can match the line.

b. Afterward, the computer will give you a score based on how well you matched its line. What's the best score you can get in three attempts?

c. After each member of the group has had a chance at the first pre-drawn graph, try a few other pre-drawn graphs. Sketch each computer graph in the space below and record your score below the sketch. Show the score and the name of the best performer in your group for each pre-drawn graph.

i. Pre-Drawn Position vs. Time 5
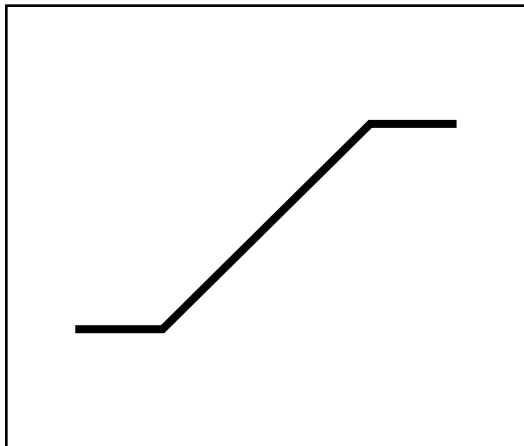


Personal Best: _____

Group Best:_____

by:_____

ii. Pre-Drawn Position vs. Time _____

Personal Best: _____

Group Best:_____

by:_____

iii. Pre-Drawn Position vs. Time ____

Personal Best: _____

Group Best:_____

by:_____

iv. Pre-Drawn Position vs. Time ____

Personal Best: _____

Group Best:_____

by:_____