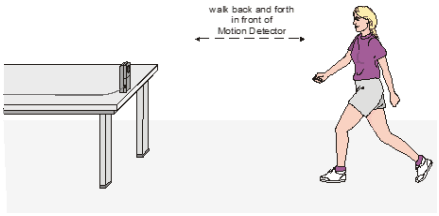
She Told Me To Walk This Way

One of the most effective methods of describing motion is to plot graphs of distance, velocity, and acceleration *vs*. time. From such a graphical representation, it is possible to determine in what direction an object is going, how fast it is moving, how far it has traveled, and whether it is. In this experiment, you will use a Motion Detector to determine this information by plotting a real time graph of *your* motion as you move across the classroom. The Motion Detector measures the time it takes for a high frequency sound pulse to travel from the detector to an object and back. Using this round-trip time and the speed of sound, you can determine the distance to the object; that is, its position. Logger *Pro* will perform this calculation for you. It can then use the change in position to calculate the object's velocity and acceleration. All of this information can be displayed either as a table or a graph. A qualitative analysis of the graphs of your motion will help you develop an understanding of the concepts of motion.



objectives

- Analyze the motion of a student walking across the room.
- Predict, sketch, and test distance *vs*. time kinematics graphs.

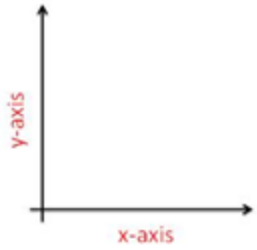
Materials

Chromebook	**vernier graphical analysis app**
motion detector	**Tape measurer**

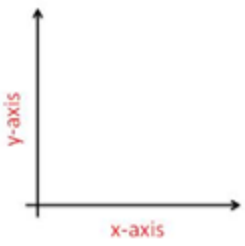
Pre-lab questions

1. Use a coordinate system with the origin at far left (0,0) and positive distances increasing to the right. Sketch the distance *vs*. time graph for each of the following situations: (y- axis is the distance (m) and x- axis is time (s))

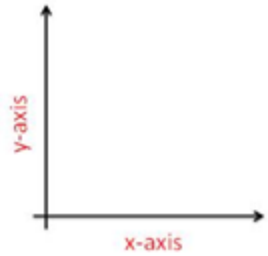
A. An object at rest



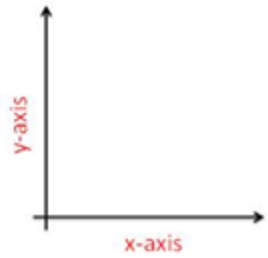
B. An object moving in a positive direction with a constant speed



C. An object moving in a negative direction with a constant speed



D. An object that is accelerating in the positive direction, starting from rest



Procedure

Part l: Set-up and Practice

Part l Preliminary Experiments

SET UP 1- CHROMEBOOK

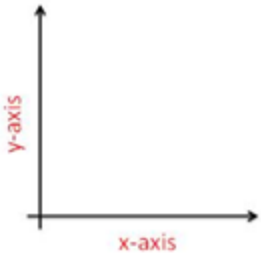
Walk this way- chromebook
Google graphical analysis vernier
Click link
Click on chrome download now
Scroll down and open launch graphical analysis
Connect Go motion motion detector
Click on sensor data collection
Click usb
Click g! Motion
Click vernier science education go motion ver 3.0 and then connect
X out of the sensors box

In the upper right corner, you will see a box to the right of the 3 dots. Click on that
You will see a green toggle graph. Change from 2 graphs to 1
On the x- axis hover over the time and drag to the right so that the time is 4 seconds.
Do the same thing for position so that it is 4 meters.

You are now ready to collect data
Press the collect button at the top to engage the motion detector

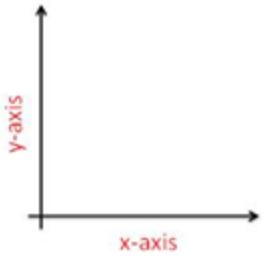
Experimentation time:

1. Using the equipment, produce a graph of your motion when you walk away from the detector with constant velocity. To do this, stand about 1 m from the Motion Detector and have your lab partner click Collect. Walk slowly away from the Motion Detector when you hear it begin to click. **Sketch** your graph



2. **Sketch** what the distance *vs.* time graph will look like if you walk faster. Check your prediction with the Motion Detector.

If you get some lines like this graph, ignore and just pay attention to the trend lines- or do it again- the better option.



a. What was the difference between the slope of the first graph (3) and the slope of the second graph?

Part 2

1. Try to match/create the shape of the distance *vs.* time graphs that you sketched in the Preliminary Questions section by walking in front of the Motion Detector.

a. What did you have to do in front of the motion detector for an object at rest?

b. What did you have to do in front of the motion detector for an object moving in a positive direction with a constant speed?

c. What did you have to do in front of the motion detector for an object moving in a negative direction with a constant speed?

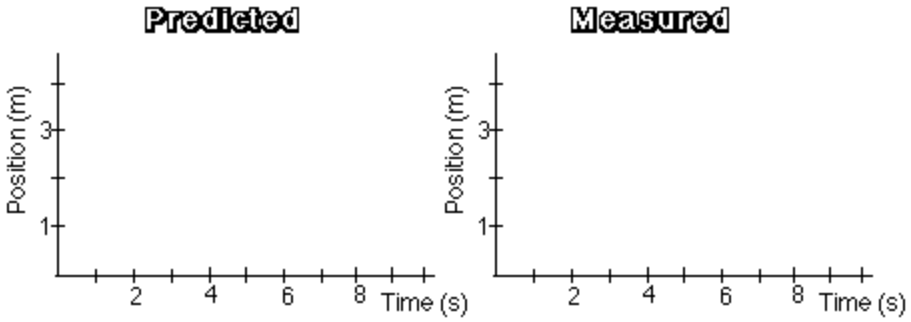
D. What did you have to do in front of the motion detector for an object accelerating in a positive direction?

Part 3 Distance *vs.* Time Graph Matching

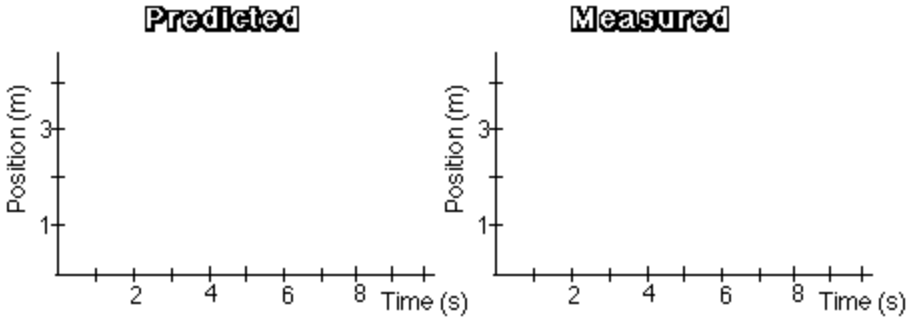
For each motion below, sketch your prediction for its position vs. time graph on the axes on the left. Then perform the motion and sketch the graph produced by the motion detector on the axes on the right.

To test your prediction, choose a starting position and stand at that point. Start data collection by clicking Collect. When you hear the Motion Detector begin to click, walk in such a way that the graph of your motion matches the target graph on the computer screen.

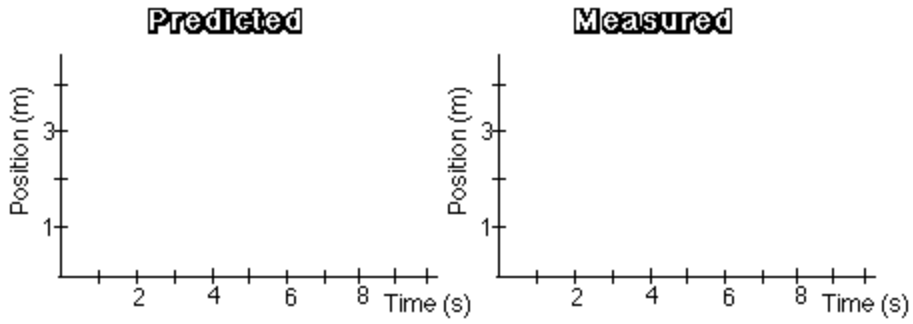
1. **Motion:** You remain at rest (motionless) at the 2-meter mark from the detector.



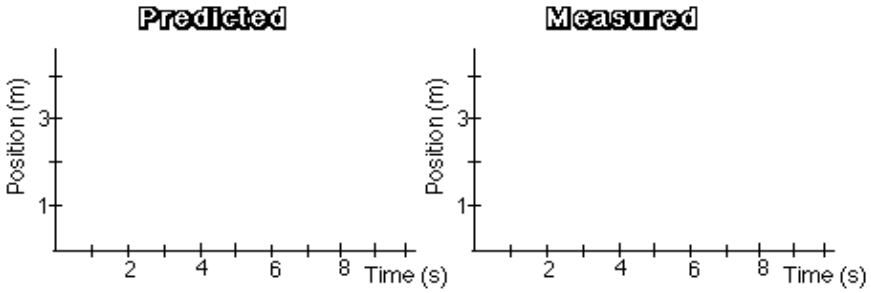
2. **Motion**: You walk slowly from the 1-meter mark to the 3-meter mark.



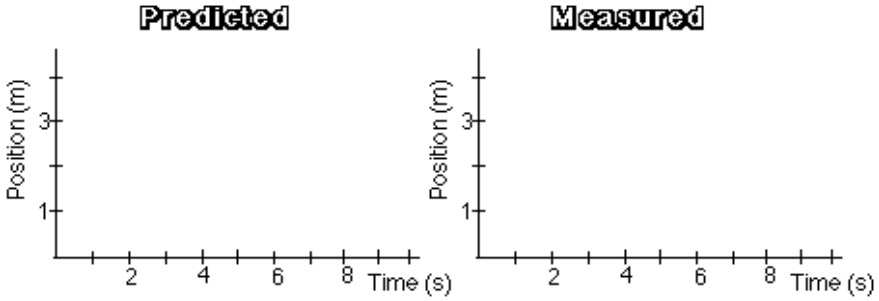
3. **Motion**: You walk slowly from the 3-meter mark to the 1-meter mark.



4. **Motion**: Starting at the 1-meter mark, you walk slowly to the 3-meter mark, then quickly back to the 1-meter mark.



5. **Motion**: Starting at the 3-meter mark, walk quickly to the 2-meter mark. Wait there for 2-3 seconds, then walk very slowly to the 0.5-meter mark.



Part IlI Distance *vs*. Time Graph Matching

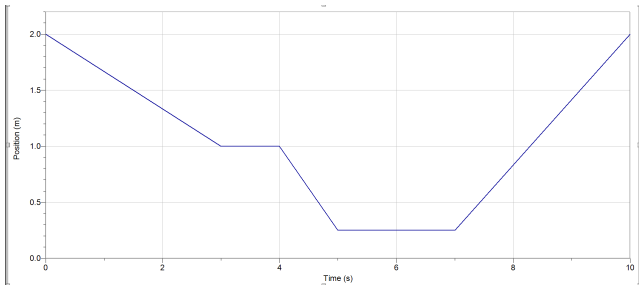
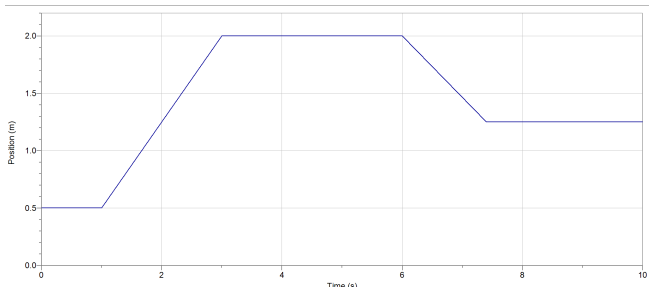
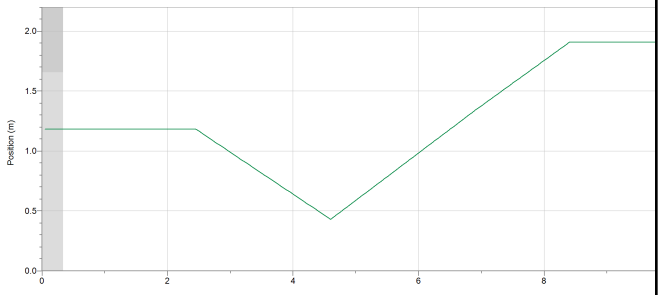
Part 3 Distance *vs*. Time Graph Matching

1. Choose A,B or C below and try to recreate this on your motion detector. Each member needs to complete a different one.

---to change the time, open the white box in the lower left corner and change the time from 5 sec to 10 sec. You should be able to manually change the position. BE SURE YOUR X AND Y AXIS MATCH BELOW BEFORE STARTING

--You may need to try this several times to get your best results. I will be checking the google doc for accuracy!

2.

	Graph	Describe how you would walk to produce this target graph. (respond to the one you made)
A		
B		
C		

3. To test your prediction, choose a starting position and stand at that point. Start data collection by clicking Collect. When you hear the Motion Detector begin to click, walk in such a way that the graph of your motion matches the target graph on the computer screen.

4. If you were not successful, repeat the process until your motion closely matches the graph on the screen.

CHECKPOINT!! Show me your screen before having the next teammate do theirs! I will be checking this in as part of your lab grade.

5. Repeat steps 1-4 for each teammate. d vs. t graph. **BE SURE EACH OF YOU SHOWS ME YOUR GRAPH!**

Analysis

1. Explain the significance of the slope of a distance *vs*. time graph. Include a discussion of positive and negative slopes.

2. What type of motion is occurring when the slope of a distance *vs*. time graph is zero?

3. What type of motion is occurring when the slope of a distance *vs*. time graph is constant and positive?

4. How did you move in front of the motion detector to increase your velocity (steeper slope)?

5. How did you move in front of the motion detector to decrease your velocity (shallower slope)?