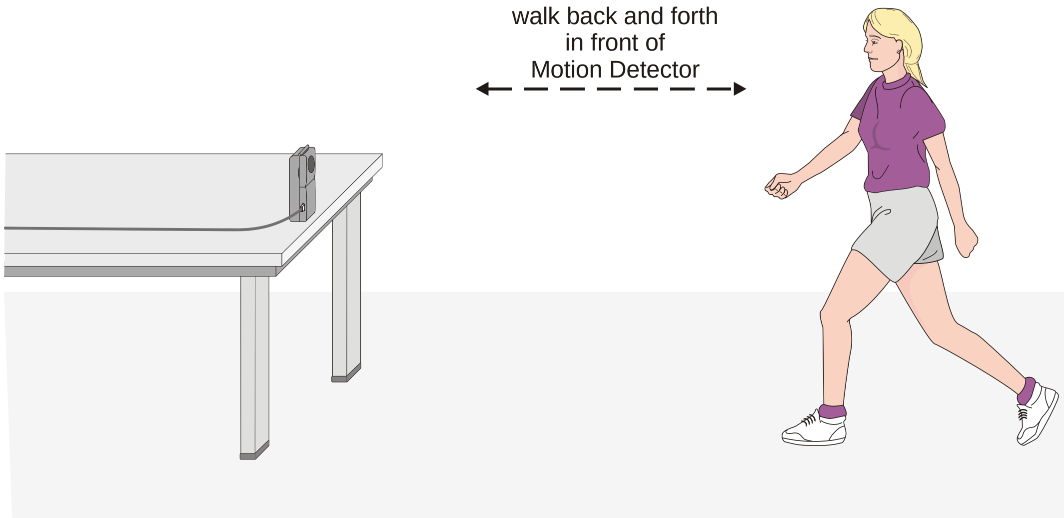
Graph Matching

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 traveled, and whether it is speeding up or slowing down. 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.



OBJECTIVES

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

MATERIALS

Computer	Vernier motion detector
Logger Pro	Vernier computer interface

Procedure

Part I: Preliminary Experiments

1. Set up the motion detector. Sign in to the computer, plug the interface into the computer, then plug the motion detector into the interface. PLUG IN THE INTERFACE POWER CORD LAST!

2. Place the Motion Detector so that it points toward a clear, open space at least 4 m long.

3. Open the Logger Pro program. Open the file “01a Graph Matching” in *Physics with Vernier*.

4. 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. Draw a sketch of your graph below:

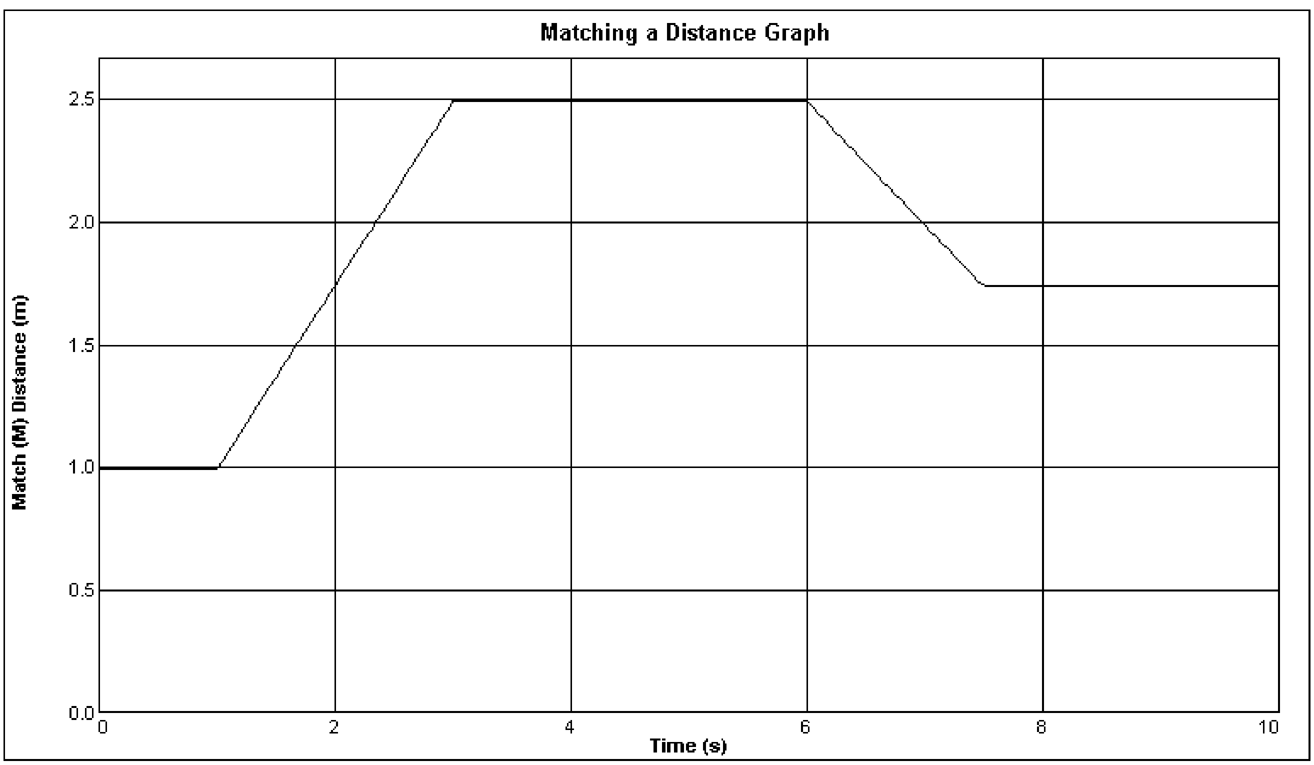
5. Sketch what the distance *vs.* time graph will look like if you walk faster. Check your prediction with the Motion Detector. Sketch your two graphs below:

Prediction *Actual graph*

6. Come get the preliminary questions from me. Try to match the shape of the distance *vs*. time graphs that you predicted by walking in front of the Motion Detector. Make any corrections in a different color.

Part II: Distance *vs*. Time Graph Matching

7. Open the experiment file "01b Graph Matching." The distance *vs*. time graph shown below will appear.
8. Determine how you should walk to produce this target graph.
9. 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.
10. If you were not successful, repeat the process until your motion closely matches the graph on the screen. When you have successfully matched your graph, each partner needs to get my signature. On the graph, thoroughly describe how you produced each segment.



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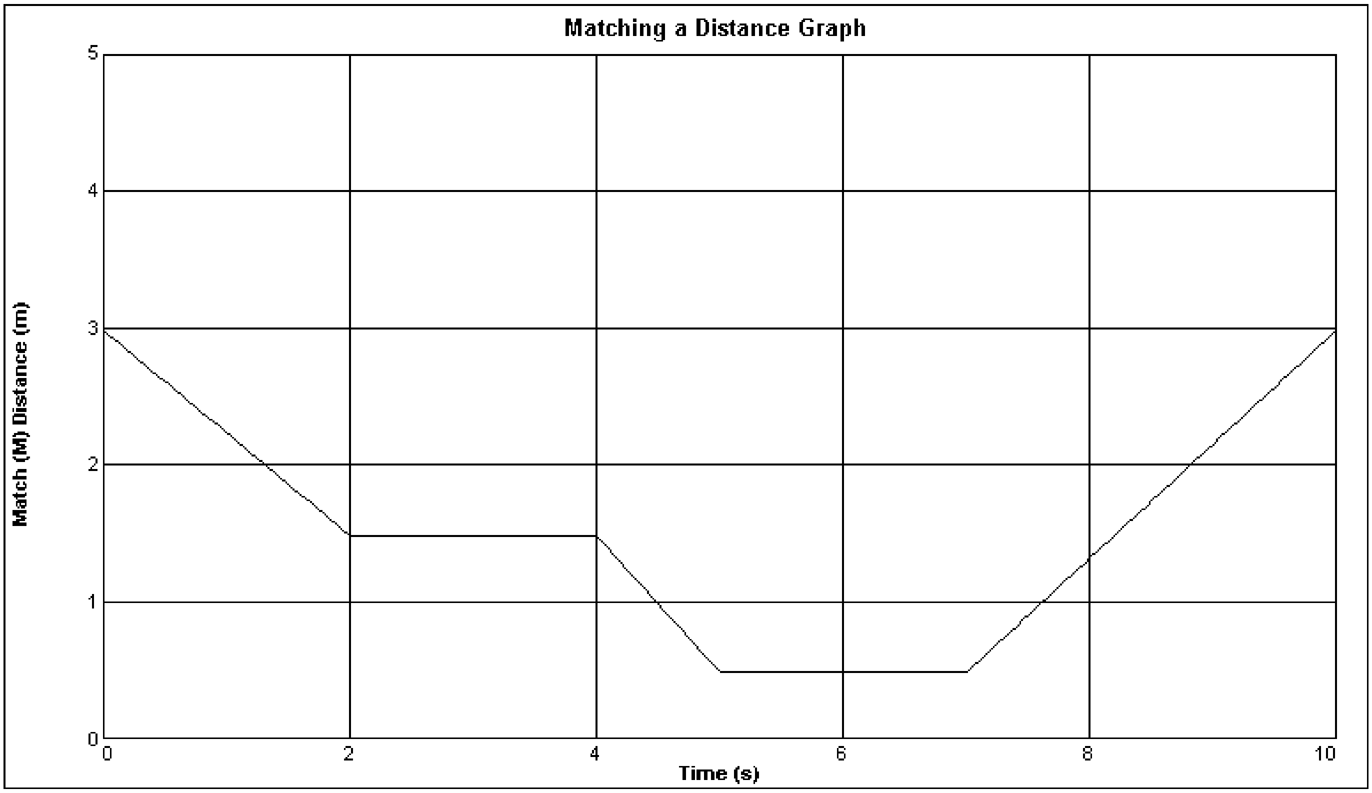
11. Open the experiment file "01c Graph Matching" and repeat Steps 8 – 10, using a new target graph.



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12. Answer the Analysis questions for Part II before proceeding to Part III.

ANALYSIS

Part II: Distance *vs*. Time Graph Matching

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

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

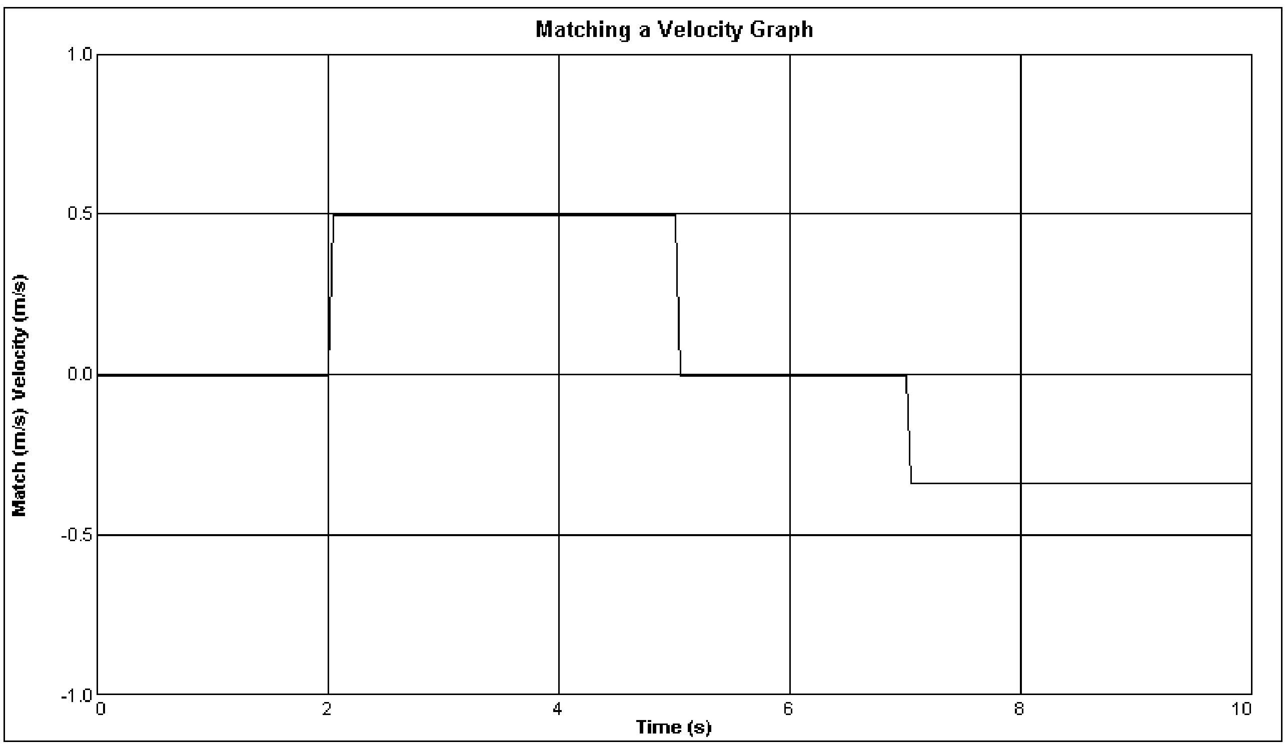
3. What type of motion is occurring when the slope of a distance *vs*. time graph is constant?

4. What type of motion is occurring when the slope of a distance *vs*. time graph is changing? How could you test your answer to this question using the Motion Detector?

PROCEDURE

Part III: Velocity *vs*. Time Graph Matching

13. Open the experiment file “01d Graph Matching.” You will see the following velocity *vs*. time graph.
14. Decide with your lab group how you should walk to produce this target graph.
15. Test your predictions.
16. When you have successfully matched your graph, each partner needs to get my signature. On the graph, thoroughly describe how you produced each segment.



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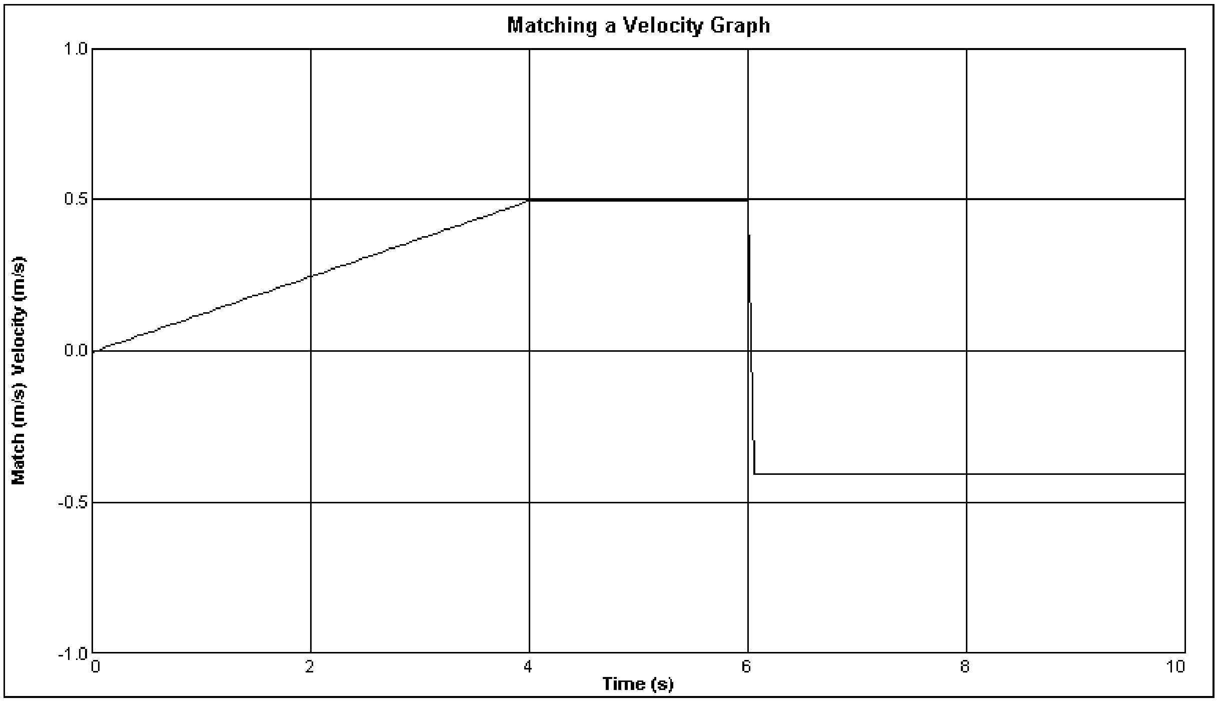
17. Open the experiment file “01e Graph Matching.” Repeat Steps 2-4 to match this graph.



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ANALYSIS

Part III: Velocity *vs*. Time Graph Matching

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

6. What type of motion is occurring when the slope of a velocity *vs*. time graph is not zero? Explain your answer using examples from the graphs.