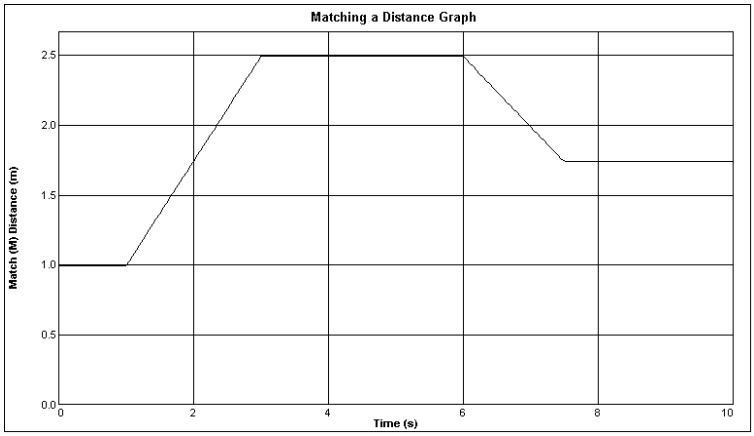
Match This Motion - Preliminary Lab

Physics

Using a motion detector, you will investigate how position, displacement, velocity, and acceleration can be graphed using *x-vs-t*, *v-vs-t*, and *a-vs-t* graphs. Work in groups of 2-4 to gather information that will prepare you for the formal lab report.

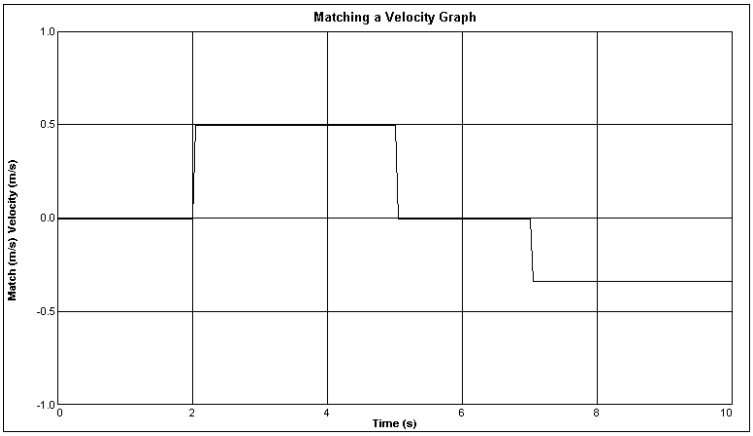
Procedure:

1. From the File menu, open the Experiment folder called *Physics with Vernier*. Then open the experiment file *01a Graph Matching*.
2. Using Logger *Pro*, produce a graph of your motion when you walk away from the detector with constant velocity. **In your notes, sketch what the *x-vs-t* graph looks like on your computer.**
3. **In your notes, sketch a prediction of what the distance vs. time graph will look like if you walk back and forth at varying speeds.** Check your prediction with the Motion Detector to see if you were correct.
4. Open the experiment file *01b Graph Matching*. The *x-vs-t* graph shown will appear.



5. **In your notes, make a detailed prediction of how you think you would walk to produce this target graph.** Include information about where you will be at various times, how long you will be there, and how quickly you will move from place to place.
6. To test your prediction, by using the motion detector. If necessary, make several trials until you are able to accurately match the graph. **In your notes, <u>discuss</u> whether your prediction from question 8 matched how you actually needed to move to match the graph on the screen.**
7. In your group, discuss:
   - What does the slope of an *x-vs-t* graph tell you about how something is moving?
   - What are the differences between positive, negative, and zero slopes on an *x-vs-t* graph?
   - What does it mean when the slope is changing on an *x-vs-t* graph (i.e., when the line on the graph is curved)?
   - What information do the coordinates of a point on an *x-vs-t* graph tell you?

   Test your ideas by using the Motion Detector. **In your notes, summarize your discussion and your observations.**
8. Open the experiment file *01d Graph Matching*. You will see the following *v-vs-t* graph.



9. **In your notes, make a detailed prediction of how you think you would walk to produce this target graph.** Include information about where you will be at various times, how long you will be there, and how quickly you will move from place to place.

10. Test your prediction using the motion detector (multiple trials will be likely). **In your notes, <u>discuss</u> the motion actually needed to move to match the graph on the screen.**

11. Once you have a fairly close match to this graph, **in your notes, sketch a prediction what the *x-vs-t* graph would look like.**

12. To check your prediction, click on the word "Velocity" on the vertical axis and change the graph so that it displays your position data instead of your velocity data. **In your notes, compare your prediction with what you see on the graph**. You'll have to remember here that since the data just reflects your best attempt to match the graph, it won't be a perfect match to an ideal prediction. **In your notes, correct your predicted *x-vs-t* graph**.

13. In your group, discuss

    - What does the slope of a *v-vs-t* graph tell you about how something is moving?
    - What are the difference between a positive, negative, and zero slope on a *v-vs-t* graph, and what do these slopes tell you about how something's speed and position are changing?
    - What information does the coordinates of a point on a *v-vs-t* graph tell you?

    Test your ideas by using the Motion Detector. **In your notes, summarize your discussion and your observations.**

14. With your group, discuss what the *area* between the graph and the time axis represents on a velocity vs. time graph. *You will need to do some additional research online or in your textbook.* **In your notes, summarize your discussion.**

15. For the various *v-vs*-t graphs you have viewed, what do you suppose an *a-vs-t* graph would look like? Use the program to inspect *a-vs-t* graphs by changing the "Velocity" or "Position" to "Acceleration".

16. You will be asked to interpret the slope, coordinates, and other features of *x*- and *v-vs-t* graphs on a test (including the area between the graph and the axis of a velocity vs. time graph). If you have extra time with the equipment, take advantage of it by challenging yourself to understand these graphs as clearly as you possibly can.