

## Velocity-Time Graphs Lab

### Teacher's Guide

**Topic:**

One Dimensional Kinematics

**The following information is provided to the student:**

**Question:**

How can the following types of motion be described with a velocity-time graph? (moving in the positive direction versus moving in the negative direction; moving fast versus moving slow; moving with a constant speed versus moving with a gradually changing speed; speeding up versus slowing down; etc.)

**Purpose:**

To contrast the shape and slope of the velocity-time graphs for the following types of motion:

- moving in the + direction versus moving in the - direction
- moving fast versus moving slow
- a constant speed motion versus a gradually changing speed
- a speeding up motion versus a slowing down motion
- moving in the same direction versus changing directions
- combinations of the above

A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion and a Discussion of Results. The Data section should include one graph for each contrasting set of two motions; axes should be labeled; labels or color coding or some other method should be used to distinguish between the two motions. The Conclusion/Discussion section should provide a thorough discussion of the differences in the velocity-time graphs for the variety of motions under study.

**Materials Required:**

Computer-interfaced motion detector and accompanying software.

**Description of Procedure:**

Once the motion detector is set up, students should walk in front of the detector and observe the resulting patterns on the velocity-time graphs. Plots can be sketched in the lab notebook and labeled accordingly. Students could make an effort to walk out the accelerated motions or use carts on inclines or fan carts instead.

**Alternative Materials and Procedure:**

Alternative procedures are not recommended.

**Safety Concern:**

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated. If using fan carts for accelerated motion, caution should be taken to not get a finger caught in the rotating blades.

## The Laboratory

### Suggestions, Precautions, Notes:

1. The plots will show lots of small bumps and *jaggies*; inform students to ignore these and simply sketch the basic shapes of the lines without the accompanying *noise*.
2. For best results students should walk very slow for a slow motion; a fast motion is simply faster than the very slow motion.
3. For best results on accelerated motions, a cart can be rolled down a hill away from and towards (careful) the detector. The cart can also be given a quick push up a hill away from and towards (careful) the detector. Alternatively, students could use fan carts (if available). Caution should be taken with the blades on a fan cart.
4. Some software programs are set to automatically scale the vertical velocity axis. This often results in an inappropriate scale as it bases the maximum value on an unusually large value obtained during a sudden movement. It is often best to manually scale the vertical axis based on an expected maximum speed (of say 2 m/s),

### Auxiliary Materials:

None

### Scoring Rubric:

<b>K6. Velocity-Time Graphs Lab</b>	<b>Score</b>
____ Included, labeled and organized all parts of the lab report. ____ Data section includes labeled and titled graphs which communicate the differences between contrasting types of motion; analyzed the different types of motion (slow vs. fast; towards vs. away; constant speed vs. changing speed; speeding up vs. slowing down; continuing in one direction vs. changing directions). Graphs are accurate and clear. ____ Conclusion/Discussion completely and accurately discusses the velocity-time graphs for the four contrasting motions. The graph features which clearly distinguish one motion from the other are clearly identified. Writing is clear, thorough and understandable.	____/____

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/1DKin/u1l4a.cfm>

<http://www.physicsclassroom.com/Class/1DKin/u1l4b.cfm>

<http://www.physicsclassroom.com/Class/1DKin/u1l4c.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevels 5-7 of the Kinematic Graphing module are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>