

TEACHER INFORMATION

Velocity Test: Interpreting Velocity Graphs

1. There are currently four Motion Detectors that can be used for this lab activity. Listed below is the best method for connecting your type of Motion Detector. Optional methods are also included:

Vernier Motion Detector: Connect the Vernier Motion Detector to a CBL 2 or LabPro using the Motion Detector Cable included with this sensor. The CBL 2 or LabPro connects to the calculator using the black unit-to-unit link cable that was included with the CBL 2 or LabPro.



MDC
cable

CBR: Connect the CBR directly to the graphing calculator's I/O port using the extended length I/O cable that comes with the CBR.

Optionally, the CBR can connect to a CBL 2 or LabPro using a Motion Detector Cable. This cable is not included with the CBR, but can be purchased from Vernier Software & Technology (order code: MDC-BTD).



I/O
cable

CBR2: The CBR 2 includes two cables: an extended length I/O cable and a Calculator USB cable. The I/O cable connects the CBR 2 to the I/O port on any TI graphing calculator. The Calculator USB cable is used to connect the CBR 2 to the USB port located at the top right corner of any TI-84 Plus calculator.

Optionally, the CBR 2 can connect to a CBL 2 or LabPro using the Motion Detector Cable. This cable is not included with the CBR 2, but can be purchased from Vernier Software & Technology (order code: MDC-BTD).



I/O
cable



USB
cable

Go! Motion: This sensor does not include any cables to connect to a graphing calculator. The cable that is included with it is intended for connecting to a computer's USB port. To connect a Go! Motion to a TI graphing calculator, select one of the options listed below:

Option I—the Go! Motion connects to a CBL 2 or LabPro using the Motion Detector Cable (order code: MDC-BTD) sold separately by Vernier Software & Technology.

Option II—the Go! Motion connects to the graphing calculator's I/O port using an extended length I/O cable (order code: GM-CALC) sold separately by Vernier Software & Technology.

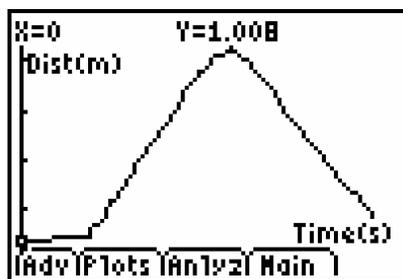
Option III—the Go! Motion connects to the TI-84 Plus graphing calculator's USB port using a Calculator USB cable (order code: GM-MINI) sold separately by Vernier Software & Technology.

2. When connecting a CBR 2 or Go! Motion to a TI-84 calculator using USB, the EasyData application automatically launches when the calculator is turned on and at the home screen.

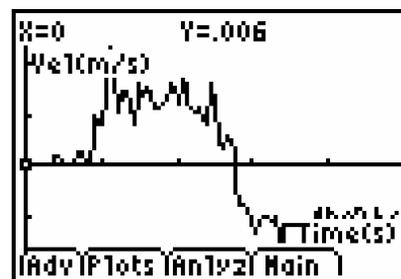
Activity 13

- Place the Motion Detector at waist-high level for the walker. The walker should not be closer than 0.5 meter to the detector when data collection begins. Clear the area of other materials such as desks or chairs.
- The instructions ask the student to walk in a particular motion: Stand still, walk away from the detector for two seconds, and then back to the detector for two more seconds. The objective of this particular walk is to create a graph that is simple to analyze in terms of slopes of segments. A more general graph can be used, but the analysis will be more complicated.
- In order to keep the distance graph simple, the walker must maintain a constant rate while walking directly away and toward the Motion Detector.

SAMPLE RESULTS



Typical distance vs. time graph



Velocity vs. time data for same run

DATA TABLE

| | t | d | | |
|---------|--------|--------|--------------------|-----------|
| point 1 | 0 s | 0.73 m | slope segment 1 | 0.01 m/s |
| point 2 | 1.00 s | 0.74 m | | |
| point 3 | 2.80 s | 1.50 m | slope segment 2 | 0.42 m/s |
| point 4 | 5.00 s | 0.64 m | | |
| | | | slope segment 3 | -0.39 m/s |

ANSWERS TO QUESTIONS

- Using the distance graph, the velocity is positive from 1.00 to 2.90 s, as judged by the positive slope.
- The slope is negative from 2.90 to 5.00 s, so the velocity is negative in this region.

3. The first 1.00 s has a velocity near zero, since the graph is nearly horizontal.
4. Sketches will vary; you can compare them to the original distance graphs.
5. Since the y-axis has units of meters, and the x-axis has units of seconds, the slope must have units of meters per second, or m/s.
6. Sketches will vary; you can compare to the original distance and velocity graphs.
7. The calculator's graph is similar to my sketch, but is more irregular.
8. The calculator will have no way to choose landmark points for slope calculation (as I did) but must instead use many points. So, the calculator's graph holds more detailed velocity information.
- 9.

| Actual Motion | Velocity Graph Characteristic |
|-------------------------------------|--------------------------------------|
| Person moves towards the detector | negative slope |
| Person stands still | zero slope |
| Person moves away from the detector | positive slope |

10. The walker started out standing just closer than 1.0 m from the detector, and was moving toward the detector when data collection began. The walker continued to move toward the detector for 2.0 s, at which time he or she turned around and walked away from the detector for two seconds. The speed away from the detector was a bit smaller than the speed toward the detector. Starting at $t = 4.0$ s, the walker stood still for the remaining time.

