

## TEACHER INFORMATION

# Graph It in Pieces: Piecewise Defined Functions

- 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  
cableUSB  
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.

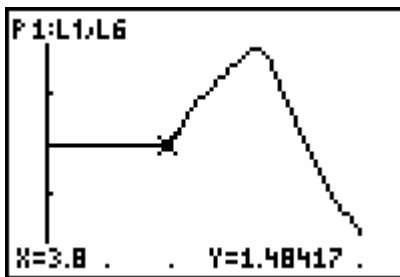
Option III—the Go! Motion connects to the TI-84 Plus graphing calculator's USB port using a Calculator USB cable (order code: GM-MINI) sold separately by Vernier Software & Technology.

- 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.

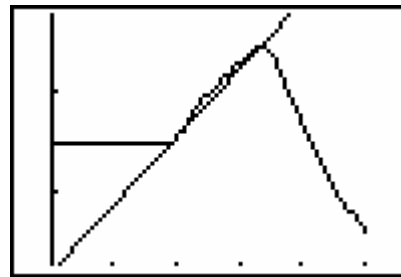
## Activity 6

- 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 students are asked to create a distance vs. time graph that contains three straight-line segments. The motion data will not be perfectly linear, so it is important to keep your students from trying again and again to get perfectly straight line segments. If some curvature is present in their graphs, they can still proceed to model the graph with line segments. The fit will be approximate, but the students will still gain experience in creating a piecewise defined function.
- This activity uses the TEST and LOGIC functions of the calculators, which may be unfamiliar to your students. You may want to discuss the use of logic functions with your class.
- The instructions in this activity become briefer as steps are repeated. This will help students generalize the very specific keystroke instructions given earlier, so that they can apply the steps to general problems in the future.
- In Step 9 of analysis students are using the point-slope form of the line equation. If you have not used this form with your students, you may want to review its use.

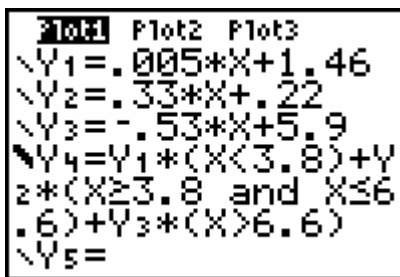
## SAMPLE RESULTS



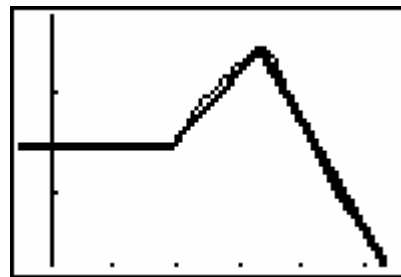
Distance data redisplayed



Distance data with second segment line



Completed model equations



Piece-wise model plotted with motion data

## DATA TABLE

$x_1$	0	$y_1$	1.46
$x_2$	3.8	$y_2$	1.48
$x_3$	6.6	$y_3$	2.41
$x_4$	10	$y_4$	0.60

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## ANSWERS TO QUESTIONS

1.  $m = 0.005$
2.  $y = 0.005x + 1.46$
3.  $m_2 = 0.33$
4. If we use the third point as the point on the second segment, the point slope form of the line becomes  $y - 2.4 = 0.33(x - 6.6)$  which is rearranged to form  $y = 0.33x + 0.22$ .
5.  $y = -0.53x + 5.90$ .
6. The slope of each segment corresponds to the velocity of the walker during each segment. The unit of the slope is m/s, or meters/second, consistent with the interpretation of the slope as a velocity.
7. The initial y-intercept is the starting distance from the Motion Detector. The unit of the intercept is m, or meters.
8. To duplicate the graph shown above, the walker must perform these steps:
  - a. Stand at a distance of 1.46 m from the detector for 3.8 s.
  - b. Walk away from the detector at 0.33 m/s for 2.8 s.
  - c. Walk toward the detector at 0.55 m/s (the negative is implied in the word “toward”) for the remaining time.