

TEACHER INFORMATION

Stepping to the Greatest Integer: The Greatest Integer Function

- 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.

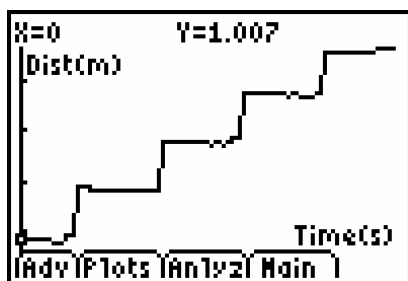
Option III—the Go! Motion connects to the TI-84 Plus graphing calculator's USB port using a Calculator USB cable (order code: GM-MINI) sold separately by Vernier Software & Technology.

- 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.
- Place the Motion Detector at waist-high level for the students. Clear the area of other materials such as desks or chairs.

Activity 21

- The biggest challenge in this activity is to get all students to do their parts at the right time and place. Space the students evenly so that the graph steps will be evenly spaced. You may want to put marks on the floor to guide the students. Space the marks by about 50 cm. At no time should anyone be closer than 1 m to the detector.
- Students must step aside when it is their turn. They must move completely out of the Motion Detector beam.
- Don't have the students line up next to a wall, as the wall may be detected by the Motion Detector.
- You might have the students graph their trial solutions to question 13. Since the endpoints are of interest, they might use the table function to inspect their formulas for specific values.

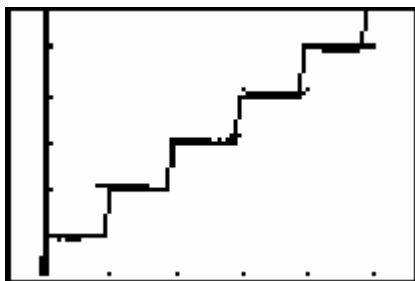
SAMPLE RESULTS



Student position data from EasyData



Data regraphed as a scatter plot



Data and optimized model

DATA TABLE

Parameter	from graph	after optimization
A	0.50 m	0.50 m
B	0.5 s ⁻¹	0.45 s ⁻¹
C	1.00 m	1.00 m

ANSWERS TO QUESTIONS

1. C represents the distance between the Motion Detector and the first student.
2. A represents the distance between students.
3. $1/B$ represents the time interval between student steps, so B is the inverse of this time. In other words, B is the rate at which students step aside, which here is about 0.5 student/s.
4. The calculator is connecting the horizontal segments of the greatest integer function with nearly vertical lines. These vertical lines should not be on the graph, since the function only is defined for the horizontal segments. Apparently the calculator is finding function values for each pixel on the graph, and then is connecting all those points with line segments. It is this last step that is causing the incorrect plotting of this function.
5. Since the students are farther away, C will be larger. Since they are closer together, A will be smaller. Since they step aside more quickly, $1/B$ will be smaller, making B larger.
6. With y as the cost and x as the time in minutes, we have $y = 0.25 - 0.15 \text{ int}(1 - x)$. Some students may answer $y = 0.25 + 0.15 \text{ int}(x)$, but this expression doesn't give the correct values for integer times.
7. The equation $y = 0.25 + 0.15 \text{ int}(x)$ doesn't work for integer x , so the endpoints of the expression need to be adjusted.