TEACHER INFORMATION

From Here to There:
Applications of the Distance Formula

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

   CBR 2: 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   USB
   cable   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. This activity requires two Motion Detectors. If a Vernier LabPro interface is used, both detectors can be connected to a single interface. If the TI CBL 2 is used, or you are connecting your Motion Detectors directly to a calculator, you must use two interfaces/detectors and two calculators, and then transfer data to a single calculator for analysis.

LabPros must have ROM version number 1.13 (code from TI) or 6.13 (code from Vernier), or newer. ROM versions x.12 and older do not fully support two Motion Detectors. To determine ROM version, notice the numbers shown on the title screen as EasyData is launched. For updates to ROM (also called firmware), see www.vernier.com.

3. 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.

4. A wooden dowel or a section of PVC plastic pipe works well. A very small diameter rod (less than 0.5 cm) will result in noisy distance data.

5. Arrange the Motion Detectors so that their faces are parallel to the edges of the pattern sheet.

6. The raw *x*- and *y*-data are shown below in sample data. The exact shape will depend on the speed of the rod during the movement.
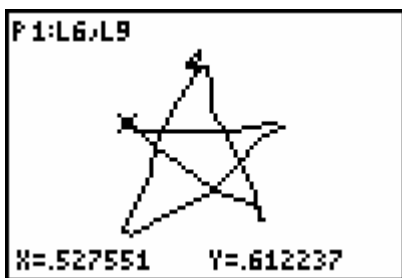
SAMPLE RESULTS
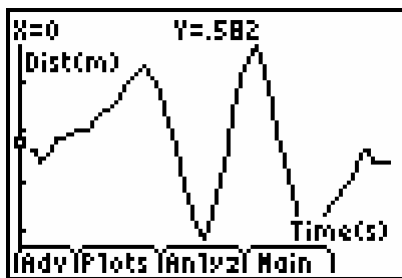
Raw *x* data in EasyData
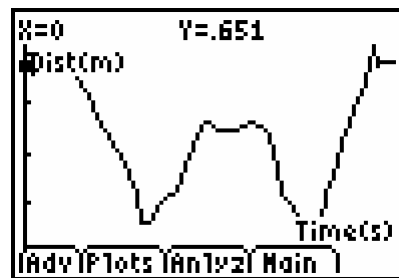
Raw *y* data in EasyData

y vs. x distance data

DATA TABLE

Distance to point A from *y*-detector 0.642 m

Point	*x*-coordinate	*y*-coordinate
A	0.581	0.650
B	0.623	0.547
C	0.527	0.612
D	0.634	0.609
E	0.521	0.538

Segment	Length using distance formula	Length using direct measurement
AB	0.111 m	0.108 m
BC	0.116 m	0.101 m
CD	0.107 m	0.104 m
DE	0.128 m	0.108 m
EA	0.124 m	0.110 m

ANSWERS TO QUESTIONS

1. The values are essentially the same, as they should be if the Motion Detector is reading the true distance from itself to the rod.

2. The *y*-coordinate is the distance from the *y*-Motion Detector to the rod, and the *x*-coordinate is the distance from the *x*-Motion Detector to the rod.

3. The segment lengths as calculated by the distance formula are nearly the same as the direct measurement values. The direct measurement values are more reliable, since they don't depend on the rod motion. My lab partner may not have moved the rod carefully!