Tracking the Path of ANIMALS

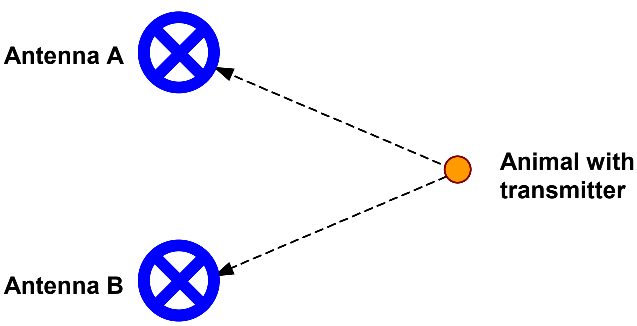
What tools and technique can you use to track the path of an animal?

ACTIVITY

Activity Overview

The agouti is a large rainforest rodent and a favorite prey of the ocelot. To hide from enemies, the agouti can run fast and swim. Powerful rear legs allow the agouti to bounce through the underbrush. Agoutis are always alert to possible predators and are ready to run away at the first sign of danger.

The Barro Colorado Island (BCI) provides researchers with the opportunity to study mammals like the agouti and the ocelot in their natural setting. Using tools, such as radio telemetry, researchers have been able to gain a great deal of knowledge about these and other mammals. Radio telemetry involves the use of transmitters and receivers to track the movement of the animals. The researchers, using a method called triangulation, then change the tracking information recorded into map coordinates. To determine the location of an animal at different times of the day, researchers plot coordinates on a map indicating the area the animal has traveled.



In this activity, you place an object in different positions on a surface to simulate the motion of an animal. You will use a Motion Detector connected to a TI CBL 2™, or Vernier LabPro, and a TI-73 Explorer™ to measure the XY coordinates of the object. After determining the locations of the object, you will use the information to draw conclusions about its movements.

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Procedure

1. Prepare your simulated terrain.

a. Use masking tape to mark a 1 m x 1 m square area on the floor, or other large surface.

b. Label two sides of the square **X axis** and **Y axis**. See figure 1.

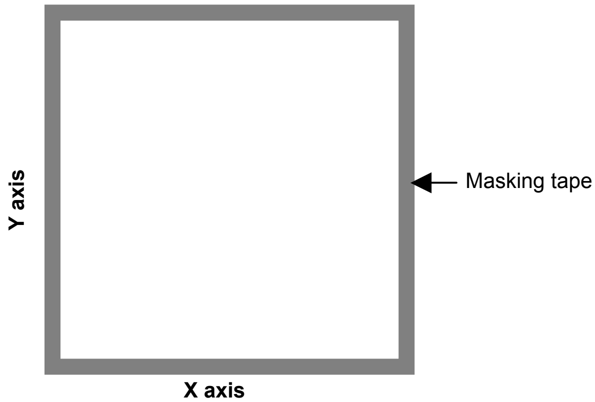


Figure 1.

2. Connect the Motion Detector to the CBL 2™, or Vernier LabPro, and TI-73 Explorer™.

a. Plug the Motion Detector into the DIG/SONIC 1 port of the CBL 2™ or Vernier LabPro.

b. Use the link cable to connect the TI-73 Explorer™ to the CBL 2™ or Vernier LabPro.

c. Firmly secure the cable ends.

3. Set up the TI-73 Explorer™.

a. Start DATAMATE. (For instructions on DATAMATE see Appendix A.)

b. Press [CLEAR] to reset the program.

c. If the Digital Channel (DIG) displays MOTION(M), proceed to Step 3h. If it does not, continue with this step to set up your sensor manually.

d. Select SETUP from the MAIN SCREEN by pressing [1].

e. Use [▲] and [▼] to select DIG: MOTION and press [ENTER].

f. Press [1] to select MOTION(M).

g. Select OK again to return to the MAIN SCREEN by pressing [1].

h. The Motion Detector automatically collects distance data in meters. You will hear a beep sound every one second as the detector collects data. The distance, in meters, is displayed on the upper right corner of the screen of your graphing device.

Materials*

- TI-73 Explorer™
- TI CBL 2™ or Vernier LabPro
- TI-73 DataMate
- Motion Detector
- Masking tape
- Small wooden block or other rectangular prism
- 1 m long metric ruler

TI-73 Explorer™

* This activity has been written for the TI-73 Explorer™ but you can easily substitute the TI-83 or TI-83 Plus. Also see Appendix A for steps on how to transfer DataMate to your graphing device and how to use DataMate for data collection.

Motion Detector

JASON

4. Place the object at Position 1.

a. The rectangular object will represent an animal. Place it on the terrain (inside your marked square) and mark its position with tape. **Important: Place the object at least 0.4 m (40 cm) away from the X axis and 0.4 m away from the Y axis to ensure accurate data collection. See Figure 2.**

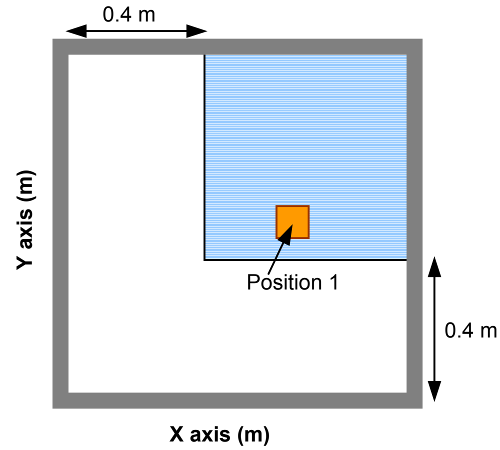


Figure 2.

5. Measure the X coordinate.

a. Copy Table 1 into your journal.

b. Place the Motion Detector on the Y axis directly across from the animal (rectangular object) as shown in Figure 3. Make sure that the round screen of the Motion Detector is facing toward the animal. By placing the Motion Detector on the Y axis you can measure the horizontal distance from X=0 m to the animal. This is the X coordinate at Position 1.

c. Once you are satisfied that your graphing device displays the correct distance, enter the X coordinate at Position 1 in Table 1.

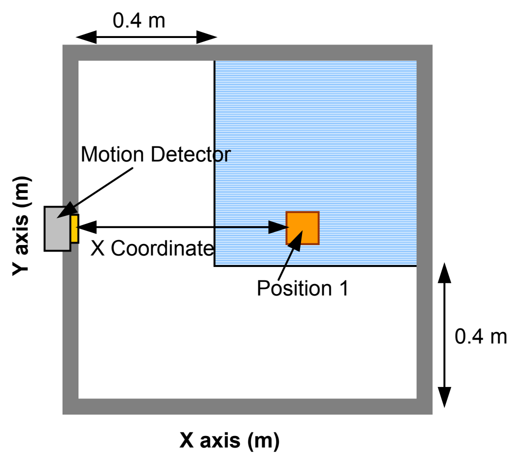


Figure 3

Table 1

	X Coordinate (m)	Y Coordinate (m)
Position 1		
Position 2		
Position 3		
Position 4		
Position 5		
Position 6		

6. Measure the Y coordinate.

d. Place the Motion Detector on the X axis directly across from the animal. Make sure that the round screen of the Motion Detector is facing the animal. By placing the Motion Detector on the X axis you can measure the vertical distance from Y=0 m to the animal. This is the Y coordinate at Position 1.

e. Once you are satisfied that your graphing device displays the correct distance, enter the Y coordinate at Position 1 in Table 1.

7. Repeat Steps 4 – 6 by placing the animal (rectangular object) in five more different positions. Mark the positions on the terrain with the marker.

8. Use the masking tape to connect the points on the terrain with lines to show the path of your animal (rectangular object).

You have measured the XY coordinates (*ordered pairs*) of the animal (rectangular object) at six different positions. You will now enter the coordinates in the TI-73 Explorer™ and then you will make a line graph to track the path of the animal.

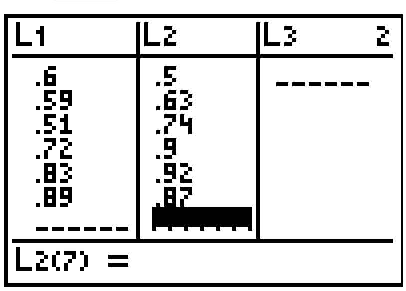
9. Enter the coordinates in the TI-73 Explorer™.

a. Press [6] [ENTER] to exit DATAMATE.

b. Press [LIST].

b. Enter the X coordinates for the animal's position in **L1.** After entering all six numbers, press [ENTER].

c. Enter the Y coordinates for the animal's position in **L2**. After entering all six numbers, press [ENTER].



Note: The numbers shown above are only given as an example. It is likely that you will have different XY coordinates

10. Graph your coordinates.

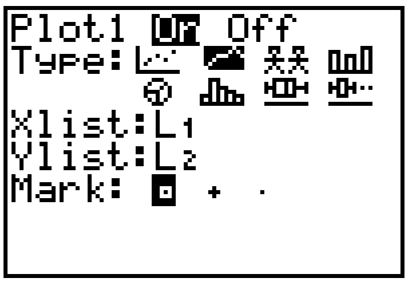
a. Press [2nd] [PLOT] [1] [ENTER] [▼] [▶] [ENTER] to select line graph (⌙⌃).

b. Press [▼] [2nd] [STAT] [1] to select **L1** (animal's X coordinate) for the X-axis.

c. Press [▼] [2nd] [STAT] [2] to select **L2** (animal's Y coordinate) for the Y-axis.

d. Press [GRAPH] to see the plot.

e. Press [ZOOM] [7] to adjust the scale on your graph.



11. Complete the Data Analysis section. Answer the questions in your journal.

Data Analysis

Note: It may be helpful to make a draft sketch of the path of the animal (rectangular object) in your journal. Label the X axis and the Y axis. Label the position number of each point on your graph.

1 The graph on your graphing device connects each two positions with a line. That line shows the distance between two positions. By observing the graph, between which two positions was the distance the greatest? Explain your thinking.

2 Between which two positions was the distance the least? Explain your thinking.

3 Between which two positions did the animal (rectangular object) move the furthest? Explain your thinking.

4 Between which two positions did the animal (rectangular object) move the least? Explain your thinking.

5 Compare the path you drew on the terrain with the graph on your graphing device. *Hint: Does the path on the graphing device look like a scale down version of the path on your terrain?*

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The steepness of the line segments on your graph may vary. The slope of a line is a number that describes how steep a line is. You can use the following formula to find the slope of a line:

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}} = \frac{\text{Vertical distance between two positions}}{\text{Horizontal distance between two positions}}$$

You can use your values in Table 1 to find the vertical distance (rise) between two consecutive positions. You can also find the horizontal distance (run) between two consecutive positions. Then you can find the slope using the above formula.

Find the slope using Table 1.

Enter your calculations in your journal.

a. Find the vertical distance between Position 1 and Position 2 (Y coordinate at Position 2 – Y coordinate at Position 1).

b. Find the horizontal distance between Position 1 and Position 2 (X coordinate at Position 2 – X coordinate at Position 1).

c. Use the slope formula above to find the slope of the line segment between Position 1 and Position 2.

6 Double the vertical distance between Position 1 and Position 2. Use the slope formula to find the slope again. How did the slope change?

7 Divide the vertical distance between Position 1 and Position 2 by two. Use the slope formula to find the slope again. How did the slope change?

You can also use your TI-73 Explorer™ to find slope. First you will find the horizontal distance (run) between two consecutive positions from L1. You will find the vertical distance (rise) between two consecutive positions from L2. Then you will find the slope of the line segment between two positions.

Find the slope of a line using the TI-73 Explorer™.

a. Press [LIST]. Move the cursor to the top of L3, highlighting L3.
b. Press [2nd] [STAT] [▸] [5] [2nd] [STAT] [1] [ENTER] to find the horizontal distance (run) into L3.
c. Scroll to the top of L4, highlighting L4.
d. Press [2nd] [STAT] [▸] [5] [2nd] [STAT] [2] [ENTER] to find the vertical distance (rise) into L4.
e. Scroll to the top of L5, highlighting L5.
f. Press [2nd] [STAT] [4] [÷] [2nd] [STAT] [3] [ENTER] to find the slope of the line between each two consecutive positions.

8 Copy Table 2 into your journal. Enter the slope for each line segment in the table.

Table 2

Line Segment	Slope
Position 1 – Position 2	
Position 2 – Position 3	
Position 3 – Position 4	
Position 4 – Position 5	
Position 5 – Position 6	

9 Examine your completed Table 2.

a. Identify the line segments that have a slope with a positive value.

b. Identify the line segments that have a slope with a negative value.

c. Identify the line segments that have a slope with a zero value.

10 Compare the values for slope with your graph on the TI-73 Explorer™.

a. If a line segment has a positive value for slope, what is the direction of the line segment? *Hint: Does it point upward, downward, or is it flat?*

b. If a line segment has a negative value for slope, what is the direction of the line segment?

c. If a line segment has a zero value for slope, what is the direction of the line segment?

Note: If Table 2 does not include a positive, negative, and/or zero values for slope find a classmate who has an example of the missing value.

11 Examine your sketch of the graph you completed in your journal. Describe how the slope values you listed in Table 2 relate to the steepness of the line segments in your graph.