

Make a

TOPOGRAPHIC MAP

ACTIVITY



Activity Overview

To build the Panama Canal, engineers dammed the Chagres River. In the process, new lakes were formed, a valley was flooded, and towns and forests were covered with water. As the waters rose, the top of a large hill known as Barro Colorado Hill was surrounded by water and became an island. Barro Colorado Hill is now called Barro Colorado Island (BCI).

In this activity, you will learn how to make a topographic map. A topographic map shows the surface features of a place or region. It uses contours to indicate the elevations of places or regions and how far apart they are. Contours are imaginary lines that join points of equal elevation on the surface of the land, usually above or below sea level. Contours make it possible to measure heights of mountains, depths of the ocean floor, and the steepness of slopes.

In order to make your topographic map, you will first prepare a simulated terrain, which consists of your classroom floor and two boxes of different sizes. You will use a Motion Detector connected to a TI CBL 2™, or Vernier LabPro and a TI-73 Explorer™, to measure the elevation of specific points on each surface. Then you will plot the coordinates of these points, and learn how to connect points of equal elevation to make your topographic map.

What information does your map give you about elevation? How can you use your map to find the position of a location? How can you use your map to find how far apart two locations are?

How can you make a topographic map, and what information can you get from it?



Make a TOPOGRAPHIC MAP

Procedure

1 Prepare your simulated terrain.

- a. Use masking tape to mark lines on the floor, as shown in Figure 1. Figure 1 which shows a top view of the terrain. You will use these lines to position the boxes. The horizontal line represents the X axis and the vertical line represents the Y axis. Label the axes.

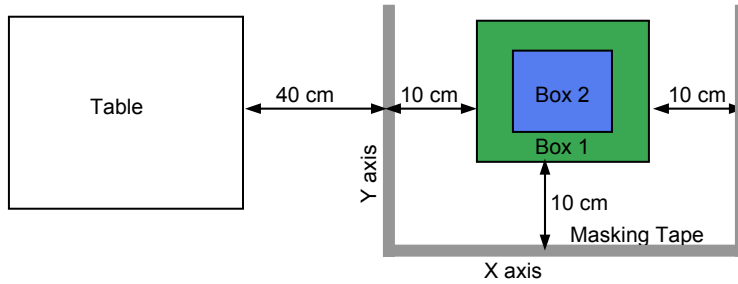


Figure 1

- b. Set up the boxes in the shape of steps on the floor underneath the Motion Detector, as shown in Figure 1. **Important: The vertical distance between the Motion Detector and the top surface of Box 2 must be at least 40 cm.**
- c. Use the chalk marker to label points A, B, C, D, E, and F on the Floor, Box 1, and Box 2 as shown in Figure 2. Mark all points at the same distance from the X axis, 35 cm.

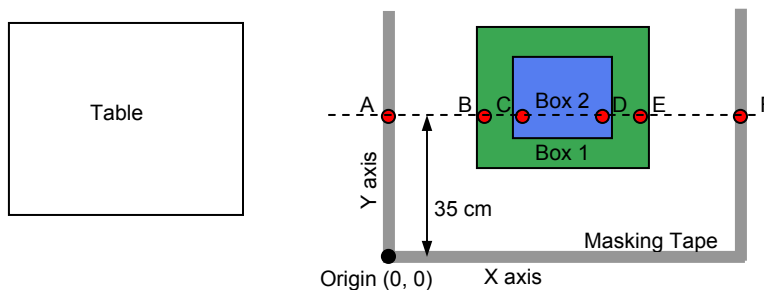


Figure 2

2 Find the XY coordinates of each point.

- a. Copy Table 1 in your journal.
- b. Assign the point where the X and Y axes meet as the origin. The X coordinate and Y coordinate at the origin are zero (0, 0).

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Materials*

- TI-73 Explorer™
- TI CBL 2™ or Vernier LabPro
- TI-73 DataMate
- Motion Detector
- 1 board, 1.5 m long to support the Motion Detector
- Masking tape
- 2 boxes of different sizes
- Chalk marker
- 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.



Adapted from "Experiment 12 — Ocean Floor Mapping," *Middle School Science with Calculators*, written by Volz, Don, and Sapatka, Sandy, published by Vernier Software & Technology, 2000.

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Table 1

Point	Measured X coordinate (cm)	Measured Y coordinate (cm)
A	0	35
B		35
C		35
D		35
E		35
F		35

- Since all points are 35 cm from the X axis the Y coordinate of each point is 35 cm, as shown in Table 1.
- Since Point A is on the Y axis its X coordinate is 0 cm, as shown in Table 1.
- Use the ruler to measure the horizontal distance from Point A to each point on your terrain. This is the X coordinate for each point. Enter the X coordinate in centimeters in Table 1. **Note: Since the points are on different surfaces it may be difficult to measure the horizontal distance. Use your chalk marker to draw vertical lines from each point to the floor, and then measure the horizontal distance between Point A and each point. See example in Figure 3.**

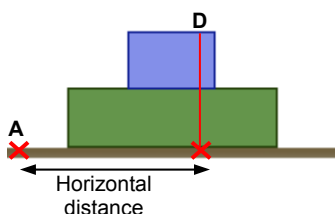


Figure 3

3 Prepare the Motion Detector to collect vertical distance data.

The Motion Detector will measure the vertical distance between each surface of the terrain and the detector in meters. You will then use the stored data and your TI-73 Explorer™ to find the elevation of each surface of the terrain. These elevations and the coordinates you measured in Step 2 will help you make your topographic map.

- Use masking tape to secure the Motion Detector to one end of the board. Make sure that the round screen of the Motion Detector is uncovered and is pointing downward.
- Place the board with the Motion Detector flat on your table as shown in Figure 4.
- Line up the Motion Detector so that when it is moved along the table edge it will pass over the floor and each of the boxes.

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Motion Detector



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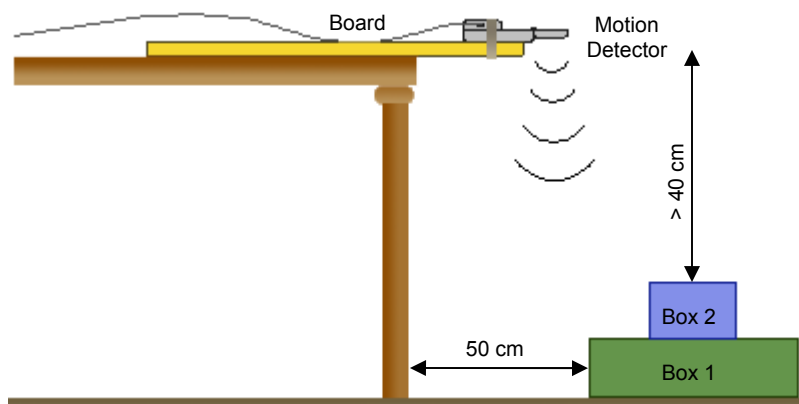


Figure 4

- 4** 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.

- 5** Set up the TI-73 Explorer™.
 - a. Turn on the TI-73 Explorer™ and start DATAMATE. (For instructions on DATAMATE see Appendix A.)
 - b. Press **CLEAR** to reset the program.
 - c. Select SETUP from the MAIN SCREEN by pressing **1**.
 - d. Use **▲** and **▼** to select MODE and press **ENTER**.
 - e. Select TIME GRAPH from the SELECT MODE MENU by pressing **2**.
 - f. Select CHANGE TIME SETTINGS from the TIME GRAPH SETTINGS MENU by pressing **2**.
 - g. Enter "0.15" as the time between samples in seconds and press **ENTER**.
 - h. Enter "300" as the number of samples and press **ENTER**. Data collection will last 45 seconds.
 - i. Select OK to return to the SETUP SCREEN by pressing **1**.
 - j. Select OK again to return to the MAIN SCREEN by pressing **1**.



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6 Collect vertical distance data.

- Select START by pressing **[2]** to begin data collection.
- After you hear a double beep, slowly slide the board on a straight line across the tabletop. Have the Motion Detector pass over the floor, then over each of the boxes, and over the floor again. See Figure 5. Wait a few seconds while the Motion Detector is on a new surface to take a more accurate reading.

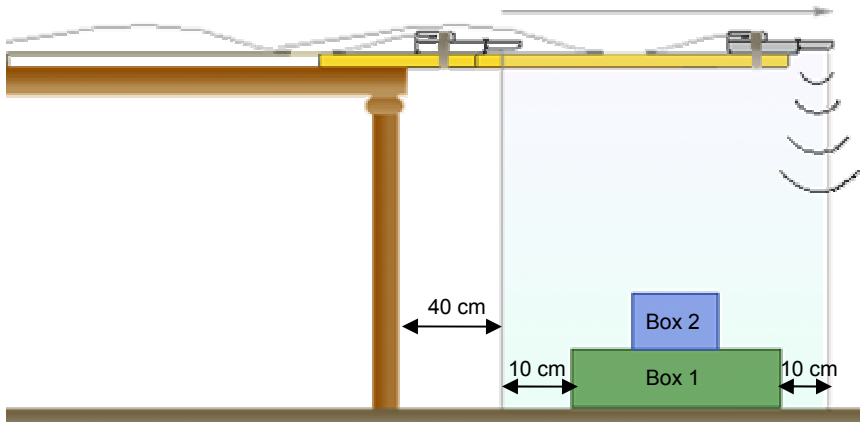


Figure 5

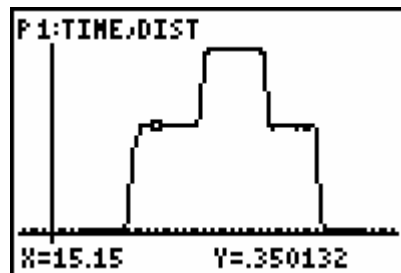
- The data collection will stop when you hear another double beep. Press **[1]** to return to the MAIN SCREEN, press **[6]** to QUIT, and then press **[ENTER]** to store your data. Time is stored in **L1** and Distance in **L6**.

7 Find the elevations.

- Move the Distance data from L6 to L2. Press **[LIST]**. Using your arrow keys, move your cursor to **L2**, highlighting L2.
- Press **[MATH] [6] [2nd] [STAT] [6] [1] [-] [2nd] [STAT] [6] [ENTER]**.

8 Graph your data

- Press **[2nd] [PLOT] [1] [ENTER] [2] [ENTER]** to select line graph (---).
- Press **[2nd] [STAT] [1]** to select **L1** (Time in seconds) for the X-axis.
- Press **[2nd] [STAT] [2]** to select **L2** (Distance in meters) for the Y-axis.
- Press **[GRAPH]**.
- Press **[ZOOM] [7]** to adjust the scale on your graph. Your final graph should resemble the shape of the boxes.



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9 Record the elevations in your journal.

- Copy Table 2 into your journal.
- The elevation of each surface is the Y value shown on the graph. Use the left and right arrow keys (←, →) to move the cursor along the curve and enter the elevation (Y value) for each point in Table 2.

Table 2

Point	Elevation (m)
A	
B	
C	
D	
E	
F	

10 Make your topographic map

- In order to make your topographic map you first need to place the XY coordinates (Step 2) on a map by plotting them on a coordinate plane. You must convert the XY coordinates to values that are smaller yet proportional to the original values. If you don't do that you will end up with a very large map. The formula below, which uses a scale, can help you find the X and Y coordinates in cm. The scale is 10:1 (ten to one). Every 10 cm on your terrain equals 1 cm on your map. For example, if the horizontal distance between Points A and C on your terrain is 50 cm, the distance on your map will be 5 cm.

$$\text{X or Y coordinate (map)} = \frac{\text{Measured X or Y coordinate}}{10}$$

- Copy Table 3 in your journal.
- Use the above formula to find the XY coordinates for the map. Enter the coordinates of each point in cm in Table 3.

Table 3

Point	Map X coordinate (cm)	Map Y coordinate (cm)
A		
B		
C		
D		
E		
F		

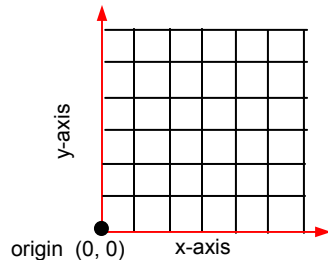


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- d. Draw a coordinate plane in your journal. Use increments of 1 cm to draw the coordinate plane as shown below.



- e. Plot the map XY coordinates of points A, B, C, D, E, and F in cm from Table 2 on the coordinate plane.
- f. Place the elevations from Table 2 next to each point on the coordinate plane.
- g. Identify the points of equal elevation and draw a circle connecting those same points. Each circle is a contour line.
- h. Label the elevations for each contour line on the coordinate plane. *Hint: Use the elevations from Table 2. You have now completed your topographic map.*
- i. Observe your topographic map and complete the Data Analysis section. Answer the questions in your journal.

Data Analysis

- 1 How many contour lines does your topographic map have?
- 2 How many elevations does your map show?
- 3 What is the lowest elevation?
- 4 What is the highest elevation?
- 5 Which points fall on the contour with the lowest elevation?
- 6 Which surface is represented by the contour with the lowest elevation?
- 7 Which points fall on the contour with the highest elevation?
- 8 Which surface represents the contour with the highest elevation?
- 9 What is the elevation of Points C and D?
- 10 Which surface do Points C and D represent?



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- 11** What is the actual distance in cm between Points B and C? *Hint: Measure the distance between the two points on the map in cm and then use the scale from Step 10 to find the actual distance in cm.*
- 12** What is the actual distance in cm between Points B and E?
- 13** What is the difference in elevation between Points B and E?



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