Name _____ Date _____

Experiment
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Ocean Floor Mapping

Oceanographers, marine geologists, and archeologists use sound to investigate objects below the surfaces of bodies of water. A signal is sent out and bounces back from a submerged surface. Scientists use the speed of sound in water and the time it takes for the signal to bounce back to calculate the depth of the object. *Sonar* is the name given to this system. The Vernier Motion Detector works in a similar manner. In this activity, you will use a Motion Detector to map objects on a simulated ocean floor.

OBJECTIVES

In this experiment, you will

- Use a Motion Detector to measure distances.
- Map simulated ocean floors.
- Analyze graphs to find the heights of objects on a simulated ocean floor.

MATERIALS

LabPro or CBL 2 interface
TI graphing calculator
DataMate program
Vernier Motion Detector
1 m board
masking tape
2 or more boxes

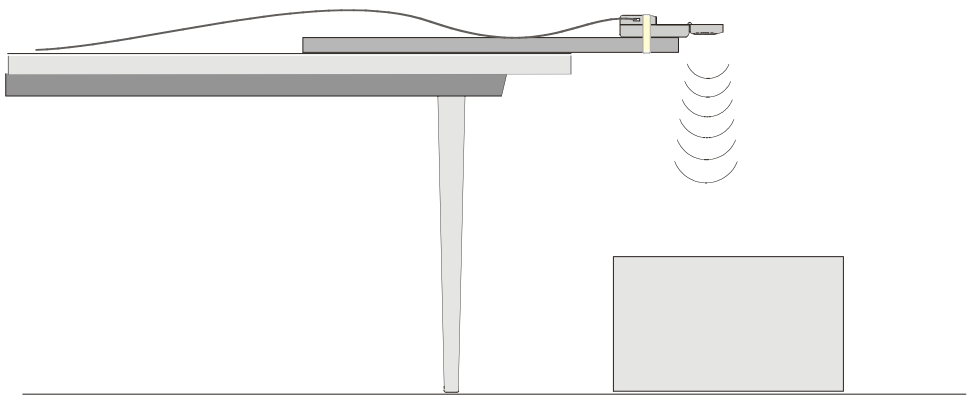

Figure 1

PROCEDURE

Part I Ocean Floor 1

1. Prepare the Motion Detector for data collection.
   a. Get the board that will act as the support for your Motion Detector.
   b. Tape or clamp the Motion Detector to one end of the board. Make sure that the round screen of the Motion Detector is not covered and is pointing downward.
   c. Place the board with the Motion Detector flat on your table as shown in Figure 1.

2. Prepare the ocean floor for data collection.
   a. Place the box on the floor underneath the Motion Detector. **Note:** The Motion Detector must be at least 40 cm from the top of the box.
   b. Line up the Motion Detector so that when it is moved along the table edge it will pass over the box.

3. Plug the Motion Detector into the DIG/SONIC 1 port of the LabPro or CBL 2 interface. Use the link cable to connect the TI graphing calculator to the interface. Firmly press in the cable ends. If the Motion Detector has a sensitivity switch, set it to Normal.

4. Turn on the calculator and start the DATAMATE program. Press CLEAR to reset the program.

5. Set up the calculator and interface for data collection.
   a. Select SETUP from the main screen.
   b. Use ▲ and ▼ to select MODE and press ENTER.
   c. Select TIME GRAPH from the SELECT MODE menu.
   d. Select CHANGE TIME SETTINGS from the TIME GRAPH SETTINGS menu.
   e. Enter **0.25** as the time between samples in seconds.
   f. Enter **60** as the number of samples. Data collection will last 15 seconds.
   g. Select OK to return to the setup screen.
   h. Select OK again to return to the main screen.

6. Collect distance data.
   a. Move the board to position the Motion Detector to the left of the box.
   b. When everything is ready, select START to begin data collection.
   c. After you hear a beep, slowly slide the board across the tabletop so that the Motion Detector passes over and past the box.

7. Determine and record the distance to the floor.
   a. After data collection stops, select MAIN SCREEN to return to the main screen.
   b. Select ANALYZE from the main screen.
   c. Select STATISTICS from the ANALYZE OPTIONS menu.
   d. Select 1-DIG-DISTANCE from the SELECT GRAPH menu.
   e. Identify a flat portion of the graph that represents the floor. Use ▶ to move the cursor to the left bound of this flat portion and press ENTER.
   f. Move the cursor to the right bound of this flat portion and press ENTER.
   g. Record the MEAN (average) distance to the floor in meters.

8. Determine and record the distance to the box.
   a. Select STATISTICS from the ANALYZE OPTIONS menu.
   b. Select 1-DIG-DISTANCE from the SELECT GRAPH menu.
   c. Identify a flat portion of the graph that represents the box. Move the cursor to the left bound of this flat portion and press ENTER.
   d. Move the cursor to the right bound of this flat portion and press ENTER.
   e. Record the MEAN (average) distance to the box in meters.

9. Sketch and label your graph.

Part II Ocean Floor 2

10. Prepare Ocean Floor 2.
    a. Set up two boxes in the shape of steps. The tallest box must be at least 40 cm from the Motion Detector.
    b. Repeat Steps 6–9. Be sure to record all three distances.

Part III Hidden Ocean Floor

11. Your teacher will have a hidden ocean floor for you to measure. Repeat Steps 6–9 for the concealed object or objects.

DATA

	Distance to floor (m)	Distance to box (m)	Box height (m)
Ocean floor 1 single box			
Ocean floor 2 box 1			
Ocean floor 2 box 2			
Hidden ocean floor box 1			
Hidden ocean floor box 2			
Hidden ocean floor box 3			

GRAPH SKETCHES

Ocean Floor 1 Ocean Floor 2 Hidden Ocean Floor

PROCESSING THE DATA

1. In the space provided in the data table above, find the height of each box. Do this by subtracting the distance to the box from the distance to the floor.

2. Which was your best result? Why do you think it was better than your other results?

3. How did the shape of your graph compare to the actual object(s) in each case? Explain.

4. What factors might affect the accuracy of real ocean-floor mapping?

EXTENSIONS

1. Try other hidden ocean-floor arrangements.
2. Research the sonar process and compare it to what you did in this activity.