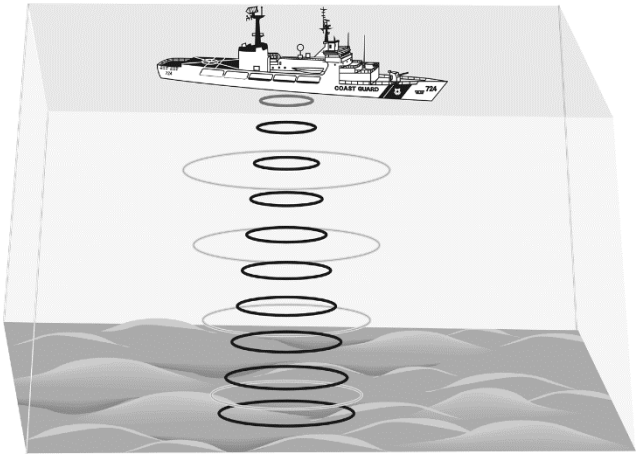
Mapping the Ocean Floor

Oceanographers, marine geologists, and archeologists use echo sounders to investigate objects below the surfaces of bodies of water. An echo sounder consists of a transducer that sends out and receives sound waves. 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. The deeper the object, the longer it takes for the sound to return. A map of the ocean floor is made by sending out a series of "pings" in a grid pattern and recording the depths. Echo sounders use different frequencies to map different things on the ocean floor.



Sonar, which is short for *so*und *na*vigation *r*anging, is the name given to this echo sounding system. It was invented during World War I to detect submarines. 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.

MATERIALS

LabQuest	1 m board
LabQuest App	masking tape
Motion Detector	2 or more boxes

PRE-LAB QUESTIONS

1. What else can you think of that measures distance by sending out a sound signal?

2. What factors make it difficult to study the ocean floor directly?

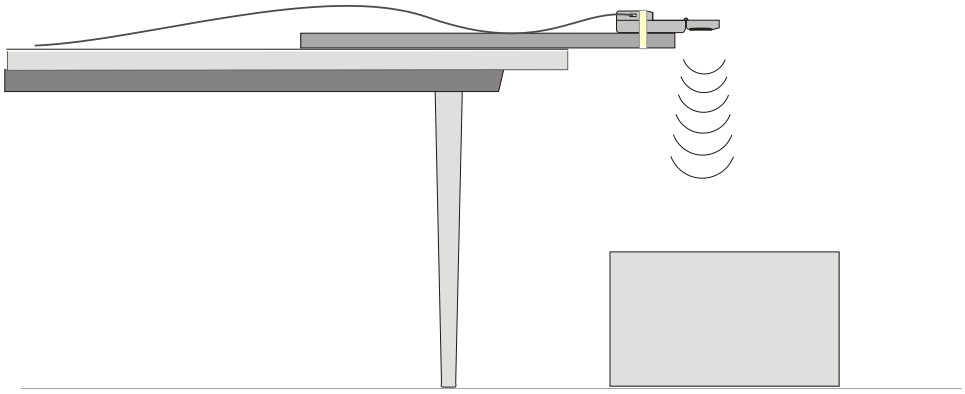
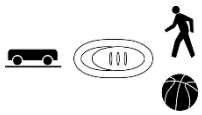


Figure 1

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. If your Motion Detector has a switch, set it to Ball / Walk. Connect the Motion Detector to DIG 1 of LabQuest and choose New from the File menu. If you have an older sensor that does not auto-ID, manually set up the sensor.



4. On the Meter screen, tap Rate. Change the data-collection rate to 4 samples/second and the data-collection length to 15 seconds.
5. On the Graph screen, tap Graph (top of screen), then Show Graph►Graph 1.
5. Collect distance data.
   a. Move the board to position the Motion Detector to the left of the box.
   b. When everything is ready, start data collection. Then, slowly slide the board across the tabletop so that the Motion Detector passes over and past the box.
6. Determine and record the distance to the floor.
   a. Identify a flat portion of the graph that represents the floor. Tap and drag your stylus across the region that represents the floor to select the region.
   b. Choose Statistics►Position from the Analyze menu.
   c. Record the mean (average) distance to the floor in meters.
   d. Choose Statistics►Position from the Analyze menu to turn off the statistics.

7. Determine and record the distance to the box.
   a. Identify the flat portion of the graph that represents the box.
   b. Tap and drag your stylus across the region that represents the box to select the region.
   c. Choose Statistics▶Position from the Analyze menu.
   d. Record the mean (average) distance to the box in meters.
8. Sketch and label your graph.

Part II: Ocean Floor 2

9. 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 5–8. Be sure to record all three distances.

Part III: Hidden Ocean Floor

10. Your teacher will have a hidden ocean floor for you to measure. Repeat Steps 5–8 for the concealed object or objects.

GRAPH SKETCHES

Ocean Floor 1 **Ocean Floor 2** **Hidden Ocean Floor**

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			

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?