

# Sonar Seas

## Mapping the Ocean Floor

### OBJECTIVE

Students will use a motion detector to measure distances and map a simulated ocean floor.

### LEVEL

Middle Grades: Earth Science

### NATIONAL STANDARDS

UCP.2, UCP.3, A.1, A.2, E.2, F.3, F.6, G.1, G.2

### TEKS

6.2(B), 6.2(C), 6.2(D), 6.2(E), 6.3(C)

7.2(B), 7.2(C), 7.2(D), 7.2(E), 7.3(C)

8.2(B), 7.2(C), 7.2(D), 7.2(E), 8.3(C), 8.14(A)

IPC1(A), 2(A), 2(B), 2(C), 2(D), 3(A)

### CONNECTIONS TO AP

AP Physics

IV Waves and Optics A. Wave motion (including sound) 1.Properties of traveling waves C. Geometric Optics 1. Reflection and refraction

### TIME FRAME

45 minutes

### MATERIALS

(For a class of 28 working in groups of 4)

7 meter sticks	masking tape
7 Power Macintosh or Windows PC	21 cardboard boxes, various sizes
7 computer interface boxes	LoggerPro software
7 motion detector probes	

### TEACHER NOTES

*Sonar Seas: Mapping the Ocean Floor* is an excellent introductory activity for students to become familiar with the sound probes and using the computer program called LoggerPro. This lab works equally well using graphing calculators with the probes. *Foundation Lesson VII: Introduction to Data Collection Devices* shows how to use the graphing calculators with probes.

Students will use motion detectors to measure the distance from the lab table to the top of a succession of boxes. Students must realize that the graph that appears on the computer is an inverse of the shape of the “ocean floor” they are mapping. It helps if students are allowed to use the motion detector probes to explore several different sample ocean floors by rearranging the boxes and repeating the procedure.

An easy way to manage the use of probes with the computer is to have the software, LoggerPro, on the computer and have a link to the software on the desktop. If the computer interface and probe is set up when the students arrive to class they should just be able to click on the LoggerPro icon. When the program opens the computer will automatically sense the motion detector and open the appropriate lab. Having this set up prior to class will reduce the amount of in class troubleshooting.

## POSSIBLE ANSWERS TO THE CONCLUSION QUESTIONS AND SAMPLE DATA

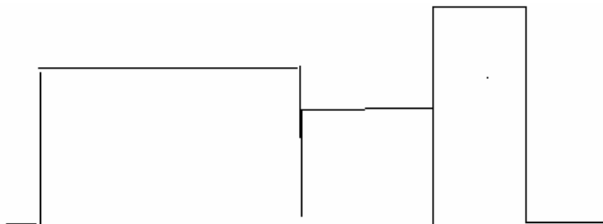
### DATA AND OBSERVATIONS

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Sketch a graph representing the first box you mapped here



Sketch a graph representing the second “ocean floor” you created here:



### ANALYSIS

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1. What was the mean of the three boxes?
  - Answers will vary, but usually range between 20 cm and 60 cm.
2. How does the graph the sonar reported to the computer differ from your drawing above? Explain why it is different.
  - The graph on the computer is an inverted picture of the actual shape of the boxes. This happens because the closer to the probe that the box is, the faster the sound bounces back.

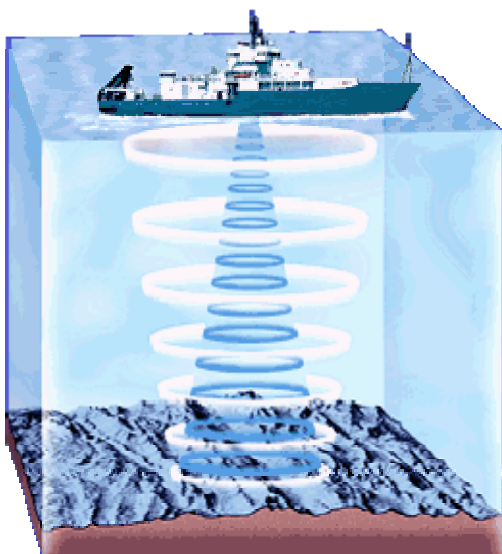
## CONCLUSION QUESTIONS

1. Explain how sonar works to map the ocean floor.
  - Sonar sends out a sound and then by measuring the amount of time it takes for the sound to hit something and bounce back, the distance can be calculated. The longer it takes for the sound to bounce back, the deeper the ocean floor is.
2. List three reasons it is important to have an accurate map of the ocean floor.
  - shipping
  - fishing
  - mining
3. What factors make it difficult to measure the ocean floor directly?
  - The ocean floor is difficult to map because we cannot see it. There is a lack of light and parts are so deep that we cannot physically go deep enough to map visually. Many instruments have difficulty surviving the pressure in the very deep parts of the ocean.
4. What animals use sonar or echo location? Why do these animals have to depend on sonar to survive? (*allow students to use resources to answer this question...textbook, Internet, encyclopedia*)
  - Bats use echo location because they are active at night and there is no light to see. Many ocean animals like dolphins and whales use echo location because they cannot see long distances in the ocean where they live.

## Sonar Seas

### 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.



Maps of the ocean floor are used for many things, including mining, fishing and sailing. The most famous use of sonar in recent years was probably the sonar discovery of the *Titanic*, which was located deep on the bottom of the Atlantic Ocean.

*Sonar*, which is short for *sound navigation ranging*, is the name given to this echo sounding system. It was invented during World War I to detect submarines. The motion detector you will use in lab works in the same way.

#### PURPOSE

In this activity you will use sonar to measure model ocean floors in the classroom and use a computer-generated graph to interpret ocean depths.

#### MATERIALS

meter stick	masking tape
computer	3 cardboard boxes, various sizes
computer interface box	LoggerPro software
motion detector probe	

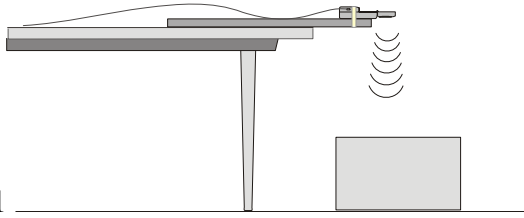


Figure 1

## PROCEDURE

1. Prepare the motion detector for data collection by taping your motion detector to a meter stick as shown in figure 1.. Make sure the round screen of the motion detector is not covered and is pointed downward.
2. Connect the motion detector into Dig/Sonic 1 of the computer interface device.
3. Place the cardboard box on the floor underneath the motion detector, again as shown in figure 1. *Note:* The motion detector must be at least 40 cm from the top of the box.
4. Line up the motion detector so that when it is moved along the table edge it will pass over the box.
5. Turn on the computer. Prepare the computer for data collection by opening the LoggerPro software. The computer should automatically open the lab using the motion detector. f.
6. Zero the sensor. Position the motion detector on the table pointing down toward the box then click on  .
7. Move the meter stick to position the motion detector to the left of the box. Click  to begin data collection. When you hear clicking, slowly slide the board across the tabletop so that the motion detector passes over and past the box.
8. After the motion detector has passed over all the boxes and data collection stops, use the mouse to select a flat portion of the graph that represents the box.
9. Click on the Statistics button, . Record the Mean (average) height of the box in meters.
10. Sketch and label your graph in the Data and Observation section on your student answer page.
11. Set up three boxes in a new orientation to imitate an ocean floor. The tallest box must be at least 40 cm from the motion detector.
12. Repeat Steps 4-7.
13. Find all three distances by clicking on the Statistics button, . Record the mean (average) height of each box in meters as the answer to question #1 in the Analysis section on the Student Answer Page.
14. Sketch and label the new graph

Name \_\_\_\_\_

Period \_\_\_\_\_

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### ANALYSIS

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2. How does the graph the sonar reported to the computer differ from your drawing above?  
Explain why it is different.

## **CONCLUSION QUESTIONS**

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