Name **Period** **Date**

Mapping the Ocean Floor

Sonar in the Science Lab

Driving Question

How do we map the ocean floor?

Materials and Equipment

For each student or group:

- ☐ Data collection system
- ☐ Motion sensor
- ☐ Graph paper
- ☐ Classroom objects for simulated ocean floor (desks, chairs, books, et cetera)

Safety

Add this important safety precaution to your normal laboratory procedures:

- Look where you are going when walking with the motion sensor.

Thinking about the Question

We have all seen a map of the world. Have you ever wondered how these maps are made? What about a map of the ocean floor? How can we know what the ocean floor looks like under all that water? Why would we want to map the ocean floor? Discuss with your partners.

One of the first methods developed to map the ocean floor was the use of a leadline. A lead-weighted line was dropped from the side of a boat. When the line struck a surface, researchers would note the distance from the ocean surface. A series of measurements over a small area provided a simple picture of a small area of the ocean basin. With your group, try this method with your shoebox models.

Mark your measurements on graph paper to build your model.

What are the limitations to this method? Could we map the whole ocean this way?

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Sonar technology is often used to gather data about the ocean basin. Ships send a signal, or energy wave, to the ocean floor. A receiver on the ship records the time it takes for the signal to be reflected and travel back to the ship. With knowledge about the velocity of the energy waves the distance to the bottom is calculated and plotted. The process is repeated for many locations until the shape of the structures becomes evident.

Sequencing Challenge

The steps below are part of the Procedure for this lab activity. They are not in the right order. Determine the proper order and write numbers in the circles that put the steps in the correct sequence.

Choose several items that you can use to model ocean floor features.	Make sure that each lab group member is aware of safety rules and procedures for this lab.	Walk at a constant velocity beside the "ocean floor" as you hold the motion sensor at a fixed height above it.	Position the items you have chosen to make the features of your ocean floor model.	Decide an appropriate height above your "ocean floor" to hold the motion sensor.

Investigating the Question

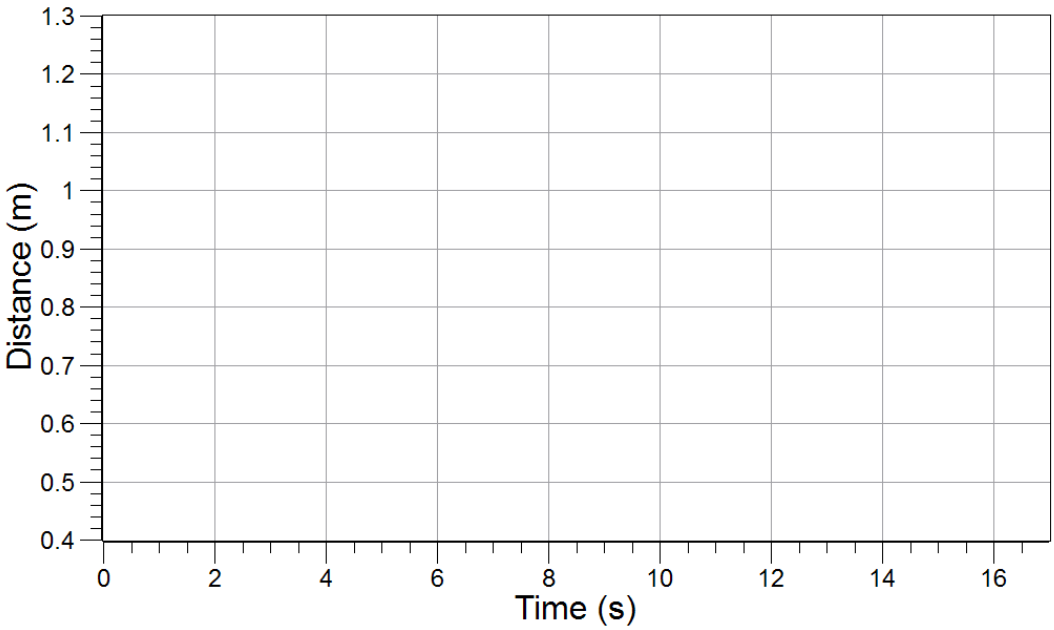
Note: When you see the symbol "�" with a superscripted number following a step, refer to the numbered Tech Tips listed in the Tech Tips appendix that corresponds to your PASCO data collection system. There you will find detailed technical instructions for performing that step. Your teacher will provide you with a copy of the instructions for these operations.

Part 1 – Setup and Prediction

1. ☐ Arrange the objects on the floor to simulate ocean floor features. Include any combination of seamounts, ocean ridges, trenches, abyssal plains or other sea floor structures.

2. ☐ Draw a prediction of the profile of the structures you have placed on the floor that you expect to see when graphed by a motion sensor.

Labeled Sketch of Ocean floor



Part 2 – Mapping the ocean floor

3. ☐ Start a new experiment on the data collection system.� (1.2)

4. ☐ Connect a motion sensor to the data collection system.� (2.1)

5. ☐ Display Position on the y-axis of a graph with Time on the x-axis.� (7.1.1)

6. ☐ Rotate the gold disk on the motion sensor so it points to the floor. Select the cart icon on the motion sensor.

7. ☐ Hold the motion sensor at arm's length over at the beginning of the "ocean floor".

8. ☐ Start data recording. �(6.2)

9. ☐ Immediately after pressing start you must begin slowly, but at constant velocity, walking with the motion sensor held over the "ocean floor".

10. ☐ Why do you think it is important to move at a constant velocity?

11. ☐ Stop data recording� (6.2) immediately when you reach the opposite end of the “ocean floor”.

Note: This could take some practice. Do not be afraid to stop collection early and try again.

Answering the Question

Analysis

1. How does the graph compare to your prediction?

2. Explain any differences between your prediction and your actual position data.

3. What would you need to do to make this graph look exactly like the profile of your "ocean floor?"

4. How is sonar or radar used by scientists to map the floor of the earth's oceans?

5. To make your results more accurate, what could be graphed on the x-axis instead of time?

6. Why is it important to map the ocean floor?

7. How has technology changed our understanding of the ocean floor?

Multiple Choice

Circle the best answer or completion to each of the questions or incomplete statements below.

1. An area of the ocean floor that plunges steeply to a very great depth is a/an
   A. Continental shelf
   B. Trench
   C. Abyssal plain
2. What was a leadline was used for in past centuries by mariners?
   A. Determining the depth of the water or the distance to the bottom of the ocean floor
   B. As a means of reckoning the speed of a ship through the water
   C. A primitive type of ship-to-ship communications device

3. A principal drawback of using a leadline was

   A. Mariners and sailors had difficulty using it properly
   B. It took a lot of effort to produce a small amount of data
   C. Ships using leadlines were more vulnerable to pirate attacks

4. How would an ocean floor map produced with sonar mainly be different from one produced without the use of such technology?

   A. The sonar map would give the actual depth for a particular location
   B. The sonar map would contain much more data
   C. The sonar map would show where the best fishing grounds would be

5. How is the motion sensor similar to the sonar devices used to map the ocean floor?

   A. The motion sensor can be used to determine an object's position, velocity, and acceleration.
   B. The motion sensor must be held still at all times
   C. The motion sensor sends out energy waves which are reflected back to their source

6. Suppose you want to model a trench, followed by a seamount, followed by an abyssal plain. Which three objects would you choose to use to build this model?

   A. A waste basket, a traffic cone, a tall box
   B. A chair, a desk, a waste basket
   C. An upside-down traffic cone, a tall box, a desk

7. Suppose you are walking in the dark with only a data collection system and a motion sensor, and you come to a gap in the path you do not want to fall into in case it is too deep. What position data from the motion sensor would most help to convince you to step into the gap?

   A. The maximum distance from the level ground to the bottom of the gap is less than 100 centimeters (cm)
   B. The minimum distance from the level ground to the bottom of the gap is 200 centimeters (cm)
   C. Each time you check the position data across the gap, there is an upward spike on the position graph

8. An area of the ocean floor that resembles a mountain chain is a/an

   A. Continental shelf
   B. Trench
   C. Mid-ocean ridge

9. What type of information would scientists *not* be able to learn from mapping the ocean floor?

   A. Whether or not organisms may be able to live in a particular location
   B. Where the continental shelf begins to slope upward toward land
   C. The likeliest direction an underwater landslide may flow

10. If you were on a sonar-carrying ship, with no land anywhere in sight, and you saw that the depth readings were decreasing steadily as you continued traveling in a particular direction, what might you conclude about the shape of the ocean floor over which you were sailing?

A. The ship must be approaching an island or continent

B. The ocean floor must be getting deeper

C. The ocean floor must be getting shallower

True or False

Enter a "T" if the statement is true or an "F" if it is false.

__________1. One form of technology used to map the floors of earth's oceans is sonar.

__________2. The motion sensor sends out a sound energy beam that reflects off a nearby object back to the sensor.

__________3. The position versus time graph of a simulated ocean floor appears exactly like the profile of the objects used to build the model.

__________4. Any change in position with respect to a reference point is known as motion.

__________5. By mapping the ocean floor, scientists can learn a great deal about the earth.