Redesigned by Chris Herald, STEM Project Coordinator

Class: 6th or 7th grade Earth Science (45 minutes for data collection)

LESSON TITLE: Ocean mapping **QUESTION:** How can a motion detector be used to map the ocean floor?
LESSON OBJECTIVES: In this experiment, students 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.
KCCR STANDARDS MATH: Mathematical Practices – 1. Make sense of problems & persevere, 2. Reason abstractly, 4. Model with mathematics, 5. Use tools strategically; **6.RP** and **7.RP** Using ratio concepts and use ratio reasoning to solve problems **KCCR STANDARDS SCIENCE: MS-ESS2-3** Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. **MS-ETS 1-4** Develop a model to generate data for testing of an object **Cross Cutting Concepts –** Patterns, Systems and Models **SEP –** Developing & Using Models, Analyzing & Interpreting data, Constructing Explanations, Using Mathematics, Obtaining, Evaluating & Communicating Information
MATERIALS: For each group-Lab Quest, motion detector attached to board/meter stick, boxes and/or textbooks, lab direction sheet & data table, exit pass
Learning activities
ENGAGE: Show video clip http://www.natgeotv.com/ca/save-the-titanic-with-bob-ballard/videos/the-discovery of Dr. Ballard finding the Titanic in 1985 or if you have access to jason.org show the Video, “Dynamic Geologic Processes” from Tectonic Fury. This brief video explains the concept of continental drift with descriptions of the mid-ocean ridge and sea-floor spreading. It also includes an animation of Pangaea and highlights Dr. Bob Ballard’s black smokers expedition.
EXPLORE: Students follow the lab directions to map the ocean floor with one box, then a second box. They determine the height of the box by subtracting the “floor” depth and box height. Ask students, how do they know which line on the graph is the floor and box? How did the shape shown on the graph compare to the shape of the actual object?
EXPLAIN: Have students share their results in small groups. What evidence do they have to determine the height of the box? What factors might affect the accuracy of real ocean floor mapping? How would results vary in the objects were much further apart? Why do scientists care about the ocean floor? What is Sonar? Which animals use this a similar system? Why is sonar used and not light?
ELABORATE: Have groups design a simulated ocean floor with a variety of objects. Allow groups to map each other’s designs. OR have a hidden ocean floor for students to map. Scientists learn more about the ocean floor from their research.
EVALUATION: Have students write one fact they learned on an exit pass and check how close their results were to the simulated hidden ocean floor http://oceanexplorer.noaa.gov/okeanos/edu/collection/media/hdwe-MMMapping78.pdf Students can map actually ocean data in Excel spreadsheet

Vocabulary or topics discussed

Science = sonar, sound, plate tectonics

Technology = using motion detectors to gather data, sonar, GIS

Engineering = interpreting graph to draw a picture, test tools to map ocean floor

Mathematics = calculating averages, rounded decimals, recognizing patterns, slope, inverse

http://www.mbari.org/earth/mar_geo/bathy/under/Background.pdf background information

Which STEM careers were highlighted? = oceanographer, marine geologist, archeologist

Ocean Floor Mapping

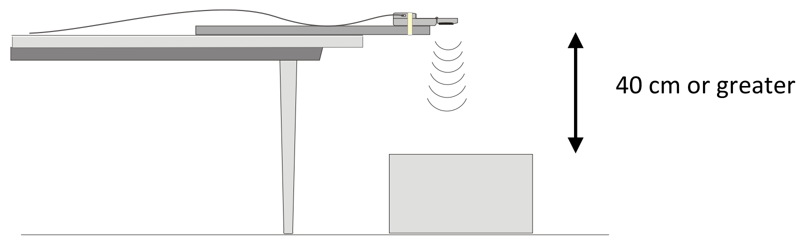
Oceanographers, marine geologists, and archeologists use sound to investigate objects below the surfaces of bodies of water. A signal is sent out and bounces back from a submerged surface. Scientists use the speed of sound in water and the time it takes for the signal to bounce back to calculate the 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.

Materials:

Lab Quest & motion detector

Meter stick

2 boxes or textbook



PROCEDURE

Part I Ocean Floor 1

1. Prepare the ocean floor for data collection:
   a. Place the box on the floor in the middle area.
   b. Line up the motion detector along the table edge, to the left of the box so it will pass over the box.

2. Decide roles for group members from these three – motion detector engineer, mathematician (recorder), and LabQuest technician. Turn the Lab Quest on.

   a. Press the red rectangle. Move the detector to point to the floor. Select Zero. Hold it still until it reads 0.0

   b. Press the red rectangle again & select reverse (a check appears in the box).

   c. Tap Rate on the right hand side of the screen. Change the **rate** to **4 samples/second**. Press "done". Change the **duration** to **15 seconds**. Press "done", then "OK".

3. Collect distance data by following these steps:

   a. Press the green arrow (left bottom area).  When you see a line appear on the Lab Quest, tell the engineer to begin to move the meter stick.
   b. Slowly slide the board across the tabletop so that the motion detector passes over and past the box. If you do not get across the table, try again. It will be OK!

4. How to determine the distance to the floor- *THINK which line represents the floor?*

   a. Identify a flat portion of the RED position <u>graph</u> that represents the <u>floor</u> (top graph).

   b. Tap a point across this region. Record the number of meters listed in the position field (on right side) in your data table.

   c. Repeat these steps for a second point along the line representing the floor.

Round distances to two decimal places.

5. How to determine and record the distance to the box-

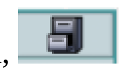
   a. Identify the flat portion of the position <u>graph</u> that represents the <u>box</u>.

   b. Tap a point across the region that represents the box. Record the number of meters listed in the position field in your data table.

   c. Repeat these steps for a second point along the line representing the box.

6. Sketch and label your graph with “floor” and “box” under the data table.

Part II Ocean Floor 2

7. Prepare Ocean Floor 2. The Lab Quest technician should press the file cabinet icon,  while other group members set up the second ocean floor explained below.

   a. Set up two boxes or several textbooks on the floor. The tallest object must be at least 40 cm from the Motion Detector. There also MUST be a SPACE between the objects.

   b. Repeat Steps 3 – 6. Be sure to record all the distances in your data table.

Part III Hidden Ocean Floor

8. Your teacher will have a hidden ocean floor for you to measure. Repeat Steps 3 – 6 for the concealed objects OR design an ocean floor for another group to map.

<u>RESULTS</u>: Find the height of each box. How would you do this? Fill in that information in the data table. There is a calculator on the Lab Quest – press the home key, then select accessories, finally calculator. Answer the questions listed on your lab sheet. Do you feel like an explorer?

Names ____ Hour __________

DATA

	Distance to floor Point 1 (m)	Distance to floor Point 2 (m)	Average	Distance to **box** Point 1 (m)	Distance to **box** Point 2 (m)	Average	Height of box (m)
Ocean floor 1 single box							
Ocean floor 2 object 2	X	X					
Hidden ocean Floor box 1							
Hidden ocean Floor box 2	X	X	X				
Hidden ocean Floor box 3	X	X	X				

GRAPH SKETCHES

Ocean Floor 1 Ocean Floor 2 Hidden Ocean 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 map?