Activity title: Hydrography, Mapping the Ocean floor with a Sounding Box

Subject: Physical Science, Math, Careers

Grade Level: 2-4

Average Learning Time: Three 40 minute- one hour lessons

Lesson Summary: Students will be introduced to hydrography, make their own group sounding box and then map the ocean floor of another group's sounding box

Overall concept (Big Idea/Essential question):

How do hydrographers collect data in order to learn more about the geographical features present in the ocean floor?

Specific concepts:

There are many geographical features on the ocean floor, such as ridges, trenches and seamounts and obstructions such as reefs, rocks, and wrecks. 71% of the Earth's surface is covered in water. The sheer volume of area to be mapped, the depth of the water, and the varied conditions make measuring the ocean floor challenging. Scientists have developed and improved methods to map the ocean floor in the face of these challenges.

Hydrographers collect data to make navigational charts. These charts are used by mariners to travel and transport goods throughout the world. Seventy-seven percent of merchandize reaches the United States by ship.
http://www.noaa.gov/features/economic_1108/commerce.html
With updated navigational charts, mariners can travel "marine highways" with confidence.

Focus questions:
Part 1
1. What are some geographical features on land?

2. Are there geographical features on the ocean floor?

Part 2
3. How can we capture data about the ocean floor?

4. How are nautical charts made from the data we collect?

Part 3
5. Why do hydrographers make nautical charts?

Objectives:

- Students will be able to list 5 physical features with 80% accuracy present on the ocean floor that affect ocean depth.

- Using their sounding box qualitative observations, students will be able to scientifically explain with 70% accuracy the observable differences between their sounding box and the grid map.

- Students will be able to apply their knowledge of measurement and mapping by solving three hydrography word problems with 70% accuracy.

Background Information:

While the ocean surface appears flat, the ocean floor has many significant topographical features that are studied for scientific purposes. For example, scientists such as Marie Tharp and Harry Hammond Hess used data collected maps of the Atlantic and Pacific Ocean floor to support the theory of continental drift.

The measurement of the depths of the oceans, often to produce a topographic map, is called bathymetry. One of the first methods of measuring the ocean floor was a lead line survey method, where a line with lead on the bottom was dropped until it hit the bottom of the ocean floor and then retrieved and measured. Until the 1920's, oceanographers measured the depth of the ocean using these lines with lead weights attached that were marked at regular intervals (meters or feet) with knots. The long lines were lowered into the ocean until the weight touched the bottom and the depth was noted by the knot mark.

Now, much more efficient sonar methods are used, sending a sound or "ping" down to the ocean floor from a ship and counting how long it takes for the sound to return to the ship. The technology, called sonar, uses sound waves to measure depth and observe features on the ocean bottom. The ship or boat has a sonar machine on the bottom that emits sound waves toward the ocean floor. By measuring the time it takes the sound to return to the ship (received by a recording device), the ocean depth can be calculated because the speed at which sound travels through water is known (1,454 meters per second). The boat travels in rows, much like mowing the lawn, collecting large swaths of depth measurements which ultimately produce a three dimensional image of the ocean floor.

(Background information provided by NOAA Chief Scientist Kevin Rademacher)

In the following activity the student will do some simplified versions of bathymetric mapping using wooden skewers simulating lead lines and to produce a simplified topographical map of their sounding box.

Common misconceptions:

- The ocean floor is flat.
- Topography of the ocean floor does not change.
- We do not use the ocean floor, so we do not need to map it.
- Most of what we consume is produced in the United States.
- Imported goods are transported by air.

Materials:

Boxes (copy paper box lids cut in half, shoeboxes or other box)

Different materials for creating topography (natural materials, combination of corn starch and glue (messy), or plaster of paris. Some use clay, puddy, duct tape, other modeling substance or even food to build the ocean floor features.

2 copies of a numbered Hundred Grid per group (One grid is taped to the top of the Sounding Box and the other grid is used by students to create their topographical map by coloring.)

Technical requirements:
Video access

Teacher preparation:

- •Read and understand all necessary scientific background information
- •Understand major student misconceptions and how best to address them
- •Assemble materials
- •Prepare a sample sounding box with chosen modeling substance

Keywords:

**Abyssal Plain*: the relatively flat area between a continental rise and mid-ocean ridge. The abyssal plain covers more than 50% of the Earth's surface.
Bathymetry: Measurement of the depths of the oceans used to determine the seafloor as with a topographic map, for scientific and other purposes.
**Continental Shelf:* the shallow area on the edges of a continent beneath the water.
**Continental Slope:* the slope between the continental edge and the deep ocean floor, or abyssal plain.
Hydrography: Measurement of depths of water in oceans, seas and lakes for many scientific purposes, but primarily to produce charts used for the purpose of safe navigation.
**Island:* a piece of land surrounded by water.
Lead Line: a line with lead attached to the bottom which was used prior to the 1920's to measure ocean depths.
**Mid-Ocean Ridge:* a long seismically active ridge in the middle of an ocean basin, such as the Mid-Atlantic Ridge
Sonar: a system for the detection of objects under water and for measuring the water's depth by emitting sound pulses and detecting or measuring their return after being reflected.
Sounding: Measurement of depth of water beneath a ship.
**Trench*: Long, narrow, deep depression in the sea floor.

Pre-assessment strategy:

Anticipatory Set:

Post word "bathymetry" on the board. Ask students to share predictions of word meaning. Call on a student to share predictions to assess for understanding.
Explain definition of bathymetry and Greek origin (deep/measure).
Replicate and post diagram below for student reference during lab.

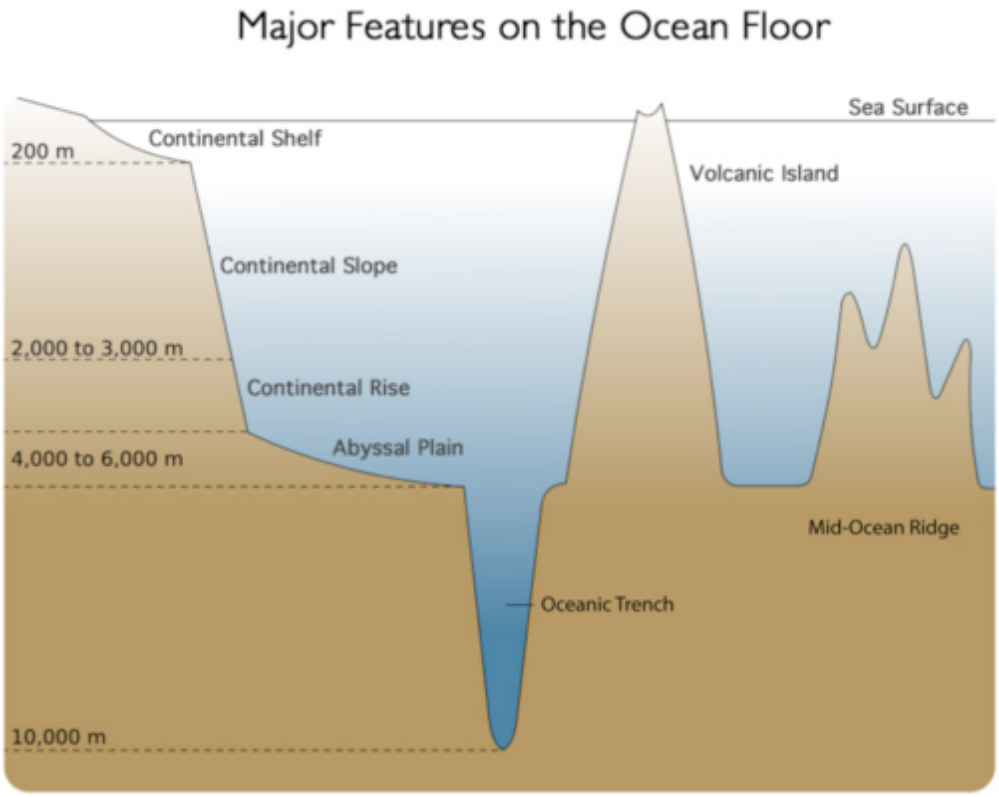

Diagram and ocean floor lesson found at:

http://www.ck12.org/book/CK-12-Earth-Science-For-Middle-School/section/14.3/

Short videos that can
Introduction to nautical charts:
http://oceantoday.noaa.gov/traveltheseas/welcome.html

and multibeam sonar:
http://www.nauticalcharts.noaa.gov/staff/education_animations.htm .

Lesson procedure:

Lesson Part 1

1. Essential question and application to Hydrography, Focus questions 1-2 to gauge student geographic background knowledge

2. Frontload 7 new vocabulary words related to major features of the ocean floor. Possible extension: have students sketch a cross section of their proposed ocean floor topography on the side of their sounding box and label the parts or have students individually complete the first part of their Sounding Box Lab Report.

3. Students design the ocean floor of their box as a group representing as many of the features introduced as possible and place items in the box. Students or

teacher cover the box with the grid and tape it firmly so that another team can not see below the surface.

Lesson Part 2

4. Groups exchange sounding boxes, either during this lesson or as a separate lesson. Discuss focus questions 3-4 to gauge mapping knowledge. Students build their own "lead line" simulator, by color coding a wood skewer with a different color every two centimeters. Then they poke holes in the sounding box grid and color in the respective number on their second grid.

5. Lab conclusion questions: students discuss answers to questions within their group. They write down answers in their own words.

Lesson Part 3: Watch video of sonar data collection at:
http://www.nauticalcharts.noaa.gov/staff/education_animations.htm

Have students share with partner why sonar technology is better than lead line surveys. Discuss. Students finish lab report.

Assessment and evaluation: completion of Sounding Box Lab Report

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Creation Date: July 2014

STANDARDS

Next Generation/State Science Standards Addressed:

2-ESS2-1 Scientists study the natural and material world.
2-ESS2-2 Develop a model to represent patterns in the natural world.
Maps show where things are located. One can map the shapes and kinds of land and water in any area.

2-ESS2-3 Obtain information to identify where water is found on Earth.

Ocean Literacy Principles and Concepts Addressed:

Essential Principle 5. The ocean supports a great diversity of life and ecosystems.

Fundamental Concept e. The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.

Essential Principle 7. The ocean is largely unexplored.

Fundamental Concept a. The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the frontier for the next

generation's explorers and researchers, where they will find opportunities for inquiry and investigation.

Fundamental Concept d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on sonar, satellites, drifters, and buoys.

Fundamental Concept f. Ocean exploration is interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, and meteorologists, and new ways of thinking.

Name: _____ Date: _____

Sounding Box Lab Report

Essential Question:

How do hydrographers collect data in order to learn more about the geographical features present in the ocean floor?

Key Vocabulary:

Abyssal Plain: the relatively flat area between a continental rise and mid-ocean ridge. The abyssal plain covers more than 50% of the Earth's surface.

Continental Shelf: the shallow area on the edges of a continent beneath the water.

Continental Slope: the slope between the continental edge and the deep ocean floor, or abyssal plain.

Island: a piece of land surrounded by water.

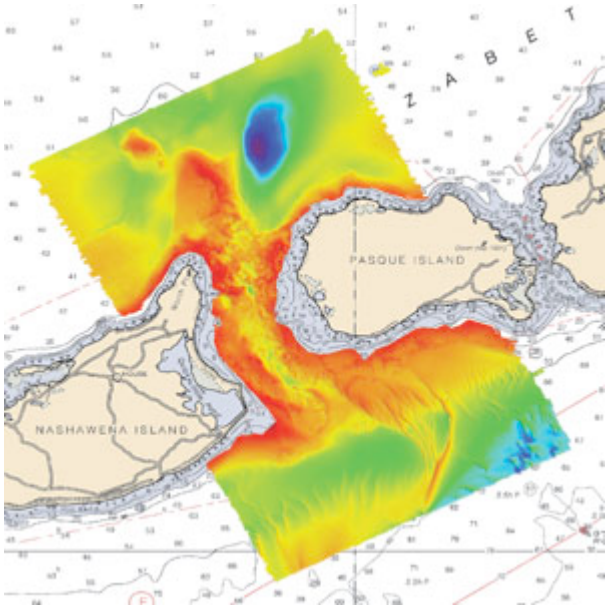
Mid-Ocean Ridge

Trench: Long, narrow, deep depression in the sea floor.

Pre-lab questions:

1. What are some geographical features on the ocean floor? Draw three features and label them.

2. Why is it hard for scientists to collect data about features on the ocean floor?



Map found at: http://www.nauticalcharts.noaa.gov/hsd/multibeam.html

3. What does this chart show? Which color represents the deepest land? Which color represents the most shallow land? Identify features of this map and why it would help the crew navigate this area safely.

4. What are two methods scientists have used to map the ocean floor? Describe each method.

5. Explain in detail whether your map represents the features you see once you take off the top of the sounding box. Propose scientific explanations for the differences observed between your grid map and the actual topography of the sounding box. Bonus: use vocabulary words Continental Shelf, Continental Slope, Abyssal Plain, Oceanic Trench, Volcanic Island and Mid-Ocean Ridge.

6. Using your knowledge of geography and what you have learned from this lab, explain how lead line surveys worked. Include in your answer tools used, best data collection methods and topographical factors that must be considered in order to get accurate depth data.

7. How do hydrographers collect data now in order to learn more about the geographical features present in the ocean floor?

Novice; (below standard)	**Partially Proficient; (almost at standard)**	**Proficient; (meets standard)**	**Advanced; (exceeds standard)**
• Can recognize a seafloor model • Can identify one color and relate it to depth on a sonar map.	• Can build a simple seafloor model • Can identify three seafloor features • Can identify two colors and relate them to depth on a sonar map	• Can build & measure a simple seafloor model • Can identify and label three seafloor features. • Can identify three or more colors on a seafloor map and relate them to depth.	• Can build, measure & graph a simple seafloor model • Can identify all parts of model & explain a lead line and sonar model. • Can identify & explain color system used on sonar seafloor map

Legend

Color your skewer and legend the same colors.

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