LESSON 4 Multibeam Mapping

Lesson at a Glance

In this lesson, students will learn why accurate maps are important and how they are being made using new technologies that go way beyond the old lead line method. They will learn about sonar and single beam mapping, then why and how multibeam mapping has now taken its place. They will then use a multibeam map of the major Hawaiian Islands to answer a series of questions.

Lesson Duration

One 60-minute period

Essential Question(s)

Why is multibeam mapping the best way to chart the seafloor?

Key Concepts

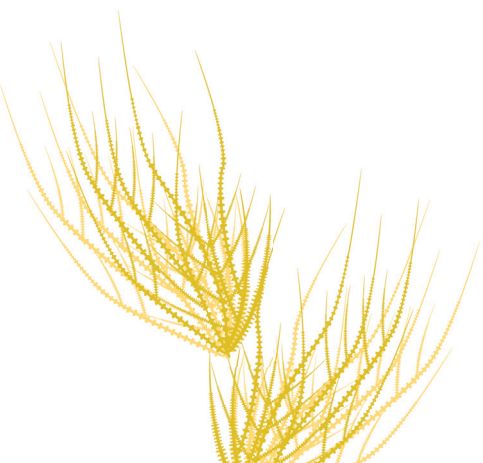
- Multibeam mapping uses sonar from many angles to create an accurate picture of the seafloor.

Related HCPSIII Benchmark(s):

Science SC.5.2.1
Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.

Instructional Objectives

- I can read a bathymetric map created by multibeam mapping and use it to model structures on the ocean floor.



Assessment Tools

Benchmark Rubric:

Topic		Unifying Concepts and Themes	
Benchmark SC.5.2.1		Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Consistently select and use models and simulations to effectively represent and investigate features of objects, events, and processes in the real world	Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world	With assistance, use models or simulations to represent features of objects, events, or processes in the real world	Recognize examples of models or simulations that can be used to represent features of objects, events, or processes

Assessment/Evidence Pieces

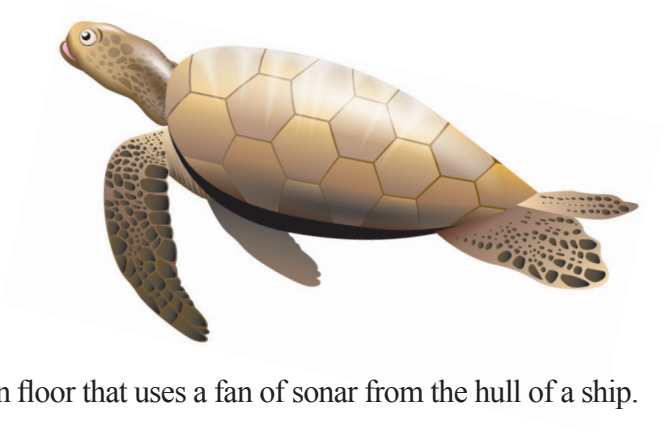
Lesson
- Student Worksheets: *Multibeam Map Reading* and *Multibeam Map*

Materials Needed

Teacher	Class	Group	Student
• Method to project PowerPoint	• None	• None	• Copies of Student Worksheets

Instructional Resources

Teacher Reading: *Multibeam Mapping*
Student Worksheet: *Multibeam Map Reading*
Student Worksheet: *Multibeam Map*
PowerPoint Presentation: *Multibeam Mapping*
Video: *Watch how multibeam mapping works*



Student Vocabulary Words

multibeam mapping: a technique for creating a map of the ocean floor that uses a fan of sonar from the hull of a ship.

Lesson Plan

Lesson Preparation

- Read the Science Background provided in the Unit's Overview, and preview the Teacher Reading *Multibeam Mapping.*
- Preview PowerPoint presentation *Multibeam Mapping* and make arrangements to project it.
- Review and make copies of the Student Worksheets *Multibeam Map Reading* and *Multibeam Map*, one per student.

- Write out Instructional Objective *I can* Statement for this lesson and post.
  - Preview an interview with John Wiltshire of NOAA's Hawaii Undersea Research Laboratory (HURL) regarding another technology used to explore undersea environments at http://www.earthsky.org/interviewpost/water/john-wiltshires-undersea-laboratory-explores-expanding-hawaii or listen to the podcast included with this unit. If appropriate, share with the students during the lesson.

I. Introduction to Multibeam Mapping

A Ask students to tell you what difficulties they had in the last lesson when they modeled measuring the seafloor. *Students should mention that they often could not tell whether they reached the seafloor, that it was hard to get an accurate measurement, and that they may have missed smaller features.*

B. Tell students that they are going to learn about a new technique – multibeam mapping – that is used today to create accurate maps of the seafloor.

C. Show the PowerPoint: *Multibeam Mapping*, using the notes to guide a discussion about multibeam mapping.

II. Multibeam Mapping the Seafloor

A. Distribute Student Worksheets: *Multibeam Map Reading* and the *Multibeam Map*, and ask students to work in partners to complete the questions using the map.

B. In a whole class discussion, review the Student Worksheet: *Multibeam Map Reading*. Students should come away from this entire unit with the following key points in mind:

- The Hawaiian Islands are volcanic and are formed at a hot spot in the Earth's crust where lava seeps out and builds the islands.
- Seamounts, guyots, and atolls are volcanic features on the seafloor.
- Multibeam mapping is a more accurate way of measuring the depth of the ocean and seafloor than profiling the seafloor with lead lines or single beam mapping.
- Accurate maps of the seafloor are necessary to aid ships in navigating the ocean and shoreline areas safely. This was true hundreds of years ago as it is today.

Extended Activities

Shipwrecks are being located as more accurate maps are being made. Shipwrecks are an exciting reason to study maps.

1. Have students research other shipwrecks around the United States: National Park Service, and Florida Shipwrecks: http://www.nps.gov/history/nr/travel/flshipwrecks/floridamap.htm

   Minnesota Historical Society: Lake Superior Shipwrecks: http://www.mnhs.org/places/nationalregister/shipwrecks/map.html

   Shipwrecks at the Mouth of the Columbia River: http://www.mapbureau.com/shipwrecks/index.html

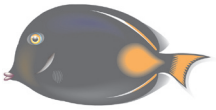
2. Have students learn more about shipwrecks around the Hawaiian Islands: http://hawaiireef.noaa.gov/research/MA/carrollton.html

LESSON 4 - Teacher Reading

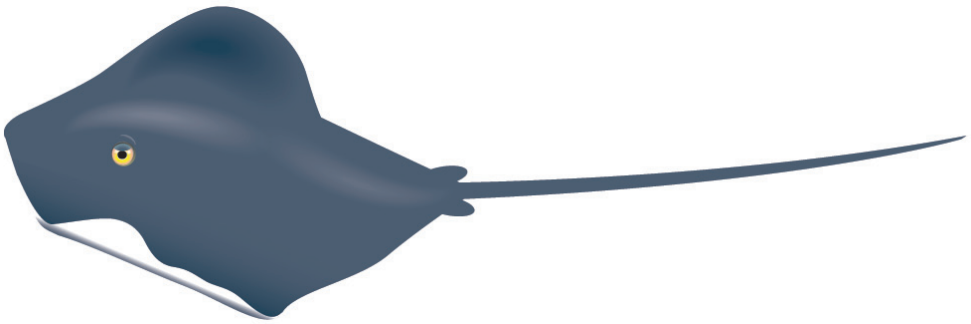
Multibeam Mapping

For many years, weighted lines were used to create maps of the ocean floor. This technique worked fairly well in shallow waters and slow-moving rivers, but was very inaccurate to measure the ocean depths. It could take a long time for the weighted line or wire to hit the ocean bottom, and it was even difficult to know whether the line had hit the ocean bottom. Currents could pull the weighted wire further from the ship, which also led to inaccurate measurements.

The limitations of earlier systems were improved upon with the advent of high-resolution **multibeam** swath-mapping systems developed in the 1990s. With multibeam systems, a fan of sound is sent out from an instrument mounted on the hull of the ship. Sound reflected back from the seafloor is recorded through narrow receivers set at different angles. Multibeam systems are able to detect depth differences as small as tens of centimeters. In addition to depth data, these systems also collect data on the amount of sound energy intensity returned from the seafloor. Because the instrument is mounted on the ship's hull, high-resolution multibeam mapping can provide positional information on seafloor locations within one meter. This technology is currently used to map and describe benthic habitat in the Northwestern Hawaiian Islands (NWHI).



Resources:
Hawai'i Mapping Research Group:
http://www.soest.hawaii.edu/HMRG/index.php



LESSON 4

Name: _____ Date: _____

Multibeam Map Reading

Directions

Follow these instructions to use the map created with multibeam mapping:

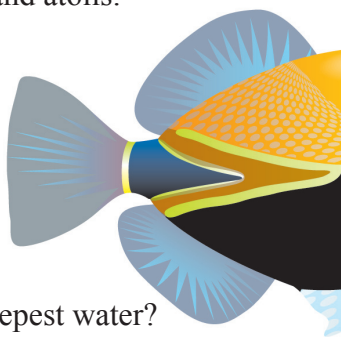
1. Identify the lowest area in terms of elevation on the map. This is the area where the water will be the deepest. Write deep water over this area.

2. Identify the highest area in terms of elevation on the map. This area is most likely at the top of a mountain (or volcano). Write mountain or volcano on this area.

3. Trace around the coastlines to identify the place where land meets water.

4. Identify and label features on the map that are underwater, including seamounts, guyots, and atolls.

5. What formed the underwater features you see on the map? Explain your answer.

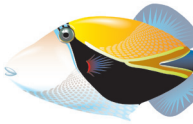


6. If you were traveling by ship, between which two islands would you be going over the deepest water?

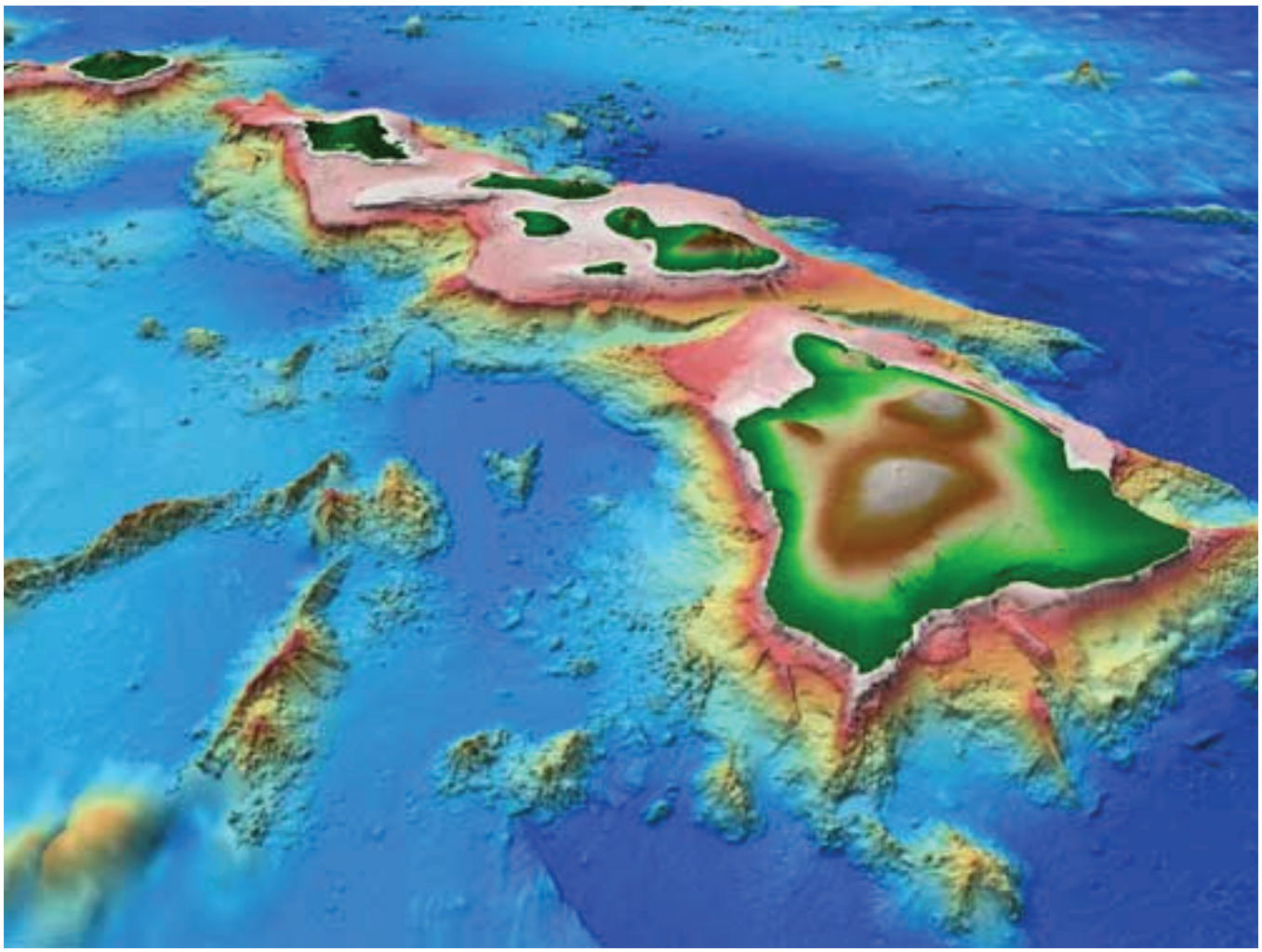
7. If you were traveling by ship, between which two islands would you be going over the shallowest water?

8. What is the advantage of single beam mapping over measuring with wires or lead lines as you saw in Lesson 3?

9. What is the advantage of multibeam mapping over single beam mapping?



Multibeam Map



Legend