LESSON 1 Where in the World is the Open Ocean?

Lesson at a Glance

The lesson begins with a hands-on activity where students discover that the Earth is 70% water and 30% land. After the realization that the ocean is vast, the class will view a presentation that will introduce them to the parts or zones of the Open Ocean and discuss why the Hawaiian Islands have no continental shelf. Next, the class will be introduced to bathymetry and how it relates to the zones of the Open Ocean. To wrap the lesson up, students will use a bathymetric map of the Hawaiian Islands to locate and describe inshore and offshore or open ocean areas.

Lesson Duration

Two 45-minute periods

Essential Question(s)

What are the zones of the open ocean?
How much of the Earth does the ocean cover?
How do we describe the open ocean around Hawai‘i?

Key Concepts

- The ocean covers 70% of the planet.
- Scientists use the term pelagic zone, usually referring to the water columns over a continental shelf (neritic zone) plus the open waters (oceanic zone) beyond the continental shelf.
- Hawai‘i is volcanic and lacks a continental shelf; the waters are divided into inshore or shallow waters and offshore or open ocean.

Instructional Objectives

- I can describe the open ocean.
- I can create a hypothesis and come to a conclusion about the water to land ratio on Earth.
- I can use a bathymetric map of the Hawaiian Islands to locate and describe inshore and open ocean areas.

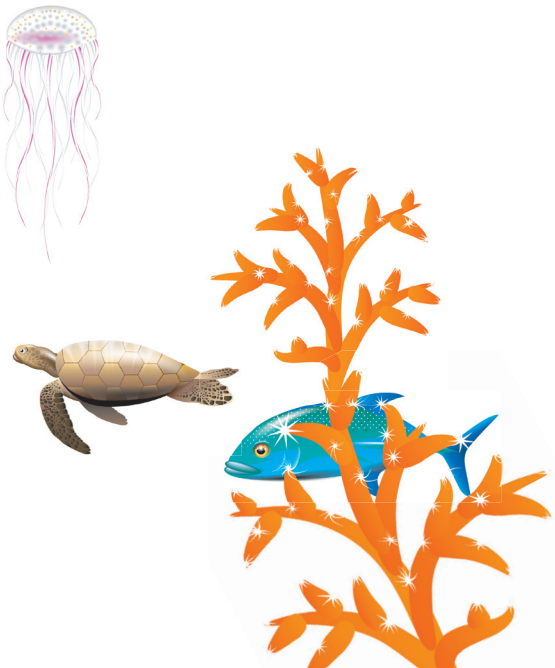
Related HCPSIII Benchmark(s):

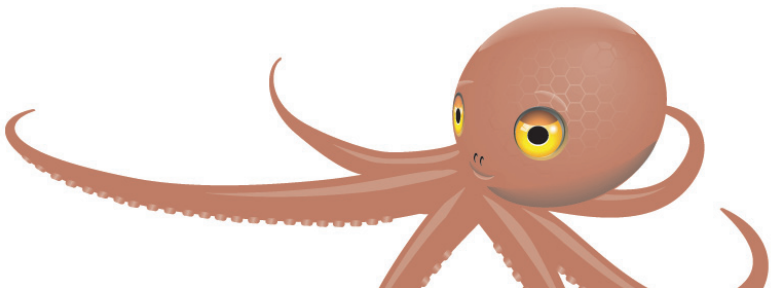
Science SC 5.1.2
Formulate and defend conclusions based on evidence.

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

Math MA 5.1.1
Represent percent and ratio using pictures or objects.

Math MA 5.10.2
Model problem situations with objects or manipulatives and use representations (e.g., graphs, tables, equations) to draw conclusions.





Assessment Tools

Benchmark Rubric:

Topic		Scientific Inquiry	
Benchmark SC.5.1.2		Formulate and defend conclusions based on evidence	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Formulate and defend conclusions that are supported by detailed evidence and make connections to the real world	Formulate and defend conclusions that are supported by evidence	Make conclusions that are partially supported by evidence	Make conclusions without evidence

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

Topic		Numbers and Number Systems	
Benchmark MA.5.1.1		Represent percent and ratio using pictures or objects	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Represent percent and ratio using pictures or objects, with accuracy	Represent percent and ratio using pictures or objects, with no significant errors	Represent percent and ratio using pictures or objects, with a few significant errors	Represent percent and ratio using pictures or objects, with many significant errors

Topic		Numeric and Algebraic Representations	
Benchmark MA.5.10.2		Model problem situations with objects or manipulatives and use representations (e.g., graphs, tables, equations) to draw conclusions	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Model problem situations with objects or manipulatives and use representations to draw conclusions, with accuracy	Model problem situations with objects or manipulatives and use representations to draw conclusions, with no significant errors	Model problem situations with objects or manipulatives and use representations to draw conclusions, with a few significant errors	Model problem situations with objects or manipulatives and use representations to draw conclusions, with many significant errors

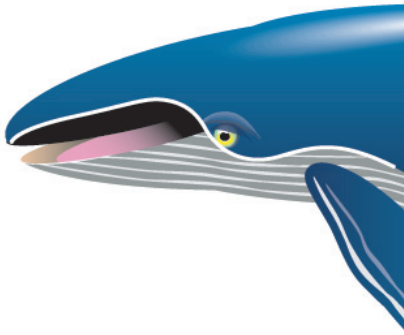
Assessment/Evidence Pieces

Lesson
- Bathymetry Worksheet
- Student hypothesis, rational for hypothesis, and conclusion from introduction activity

Materials Needed

Teacher	Class	Group	Student
• Method to present PowerPoint • Optional: World map showing oceans • Map of Hawaiian Island chain • Inflatable Globe • Stickers (small)	• None	• None	• Student Worksheet: *"The Open Ocean" Notes* • Student Worksheet: *Bathymetry*

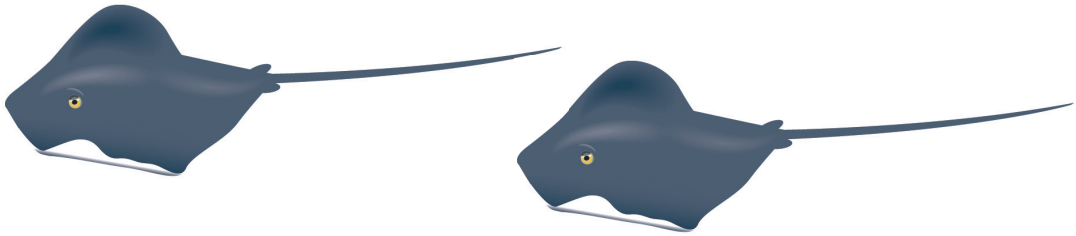
Instructional Resources



PowerPoint Presentation: *The Open Ocean*
PowerPoint Presentation: *Big Blue Marble*
Teacher Reading: *Bathymetry and Open Oceans*
Student Worksheet: *"The Open Ocean" Notes (A 6-square graphic organizer)*
Student Worksheet: *Bathymetry*

Student Vocabulary Words

benthic zone: bottom portion of ocean, also called seafloor, or sometimes seabed.
bathymetry: the measurement of water depth at various places in the ocean.
inshore: shallow water around a land mass that includes ecosystems, such as coral reefs, estuaries, bays, etc. Less than 100 meters (328 ft.) off the coast; in Hawai'i, sometimes called nearshore or coastal waters.
open ocean: deep ocean waters beyond the inshore zone usually, more than 500 meters (984 ft.) off the coast.



Lesson Plan

Lesson Preparation

- Review the Science Background provided in the Unit Overview and the Teacher Reading *Bathymetry and Open Oceans.*
- Preview the PowerPoint Presentations *The Open Ocean* and *Big Blue Marble*; make arrangements to project them.
- Make copies of the Student Worksheets *Bathymetry* and *"The Open Ocean" Notes*, one per student.
- (Optional) On chart paper, make two categories "Land" and "Ocean." Use this chart paper in Section I as you tally up the number of stickers found on land and on the ocean.

I. Pin the sticker on the water

A. In this activity, students will stick stickers onto a spinnable globe to get a better idea of how much water is on Earth (approximately 70% of the Earth's surface is covered by water). Explain to the students that they will close their eyes and each take a turn spinning the globe. As the globe slows down, the student whose turn it is will place his/her finger on the globe. At the place where the student's finger lands, put a sticker.

B. Write the word "hypothesis" on the board. Elicit prior knowledge, by asking students to share what they know about what a hypothesis is. If necessary, define a hypothesis as "an idea that can be tested by an experiment or observation" (ScienceSaurus, 2005). Review with students that either of the following formats may be used: "if...then..." or "if...then...because..."

C. Work with students to create a hypothesis. With the globe in hand for the class to see, ask them to write down a hypothesis regarding where they think the most stickers will be located on the globe at the end of the activity. Will the stickers be mostly on the land or covering the water? Ask the students to write down reasons to support their hypothesis. You may want to have students go one step further by making predictions as to exactly how many stickers will be on water and on land, given the number of students in the class. Again, students should explain the reasoning behind the prediction.

D. Carry out the Activity. Have each student spin the globe, close their eyes and put their finger somewhere on the globe and place a sticker on that spot each time.

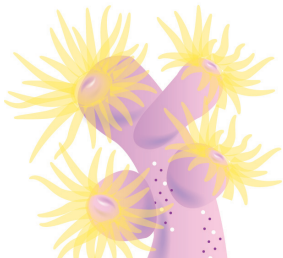
E. Tabulate and Analyze the Data. Have students count the number of dots on water and on land. Create a graph to organize the data. It is almost certain that some dots will be on both land and water so there will need to be discussion and decision regarding how to count those dots. Have students use calculators to compute the percentage of stickers that were on water, and the percentage that were on land. Water/land percentages should be approximately 70/30. If the class's result is somewhat different, you may need to discuss the experimental process and talk about the concept of "average results" over numerous trials.

F. Using the calculated data, each student should determine if the hypothesis he/she made is supported or not supported. Then, the students can write a conclusion about their hypothesis. Have a few students volunteer to share their hypothesis, whether it was supported or refuted, and their final conclusion. Discuss these as a group. At the end of the students information sharing, be sure to make clear that the Earth has approximately 70 percent water and 30 percent land.

G. To reinforce the ocean to land percentages the class just figured out, view PowerPoint *Big Blue Marble*. Consider the following questions to guide the discussion:

   1) Why is the Earth sometimes called the "Big Blue Marble?"

   2) What would life be like as an organism living in the open ocean?



II. Open Ocean Zones

A. Explain to the class that scientists divide the ocean into zones according to the amount of light that reaches a certain depth or according to the diversity of life can be sustained at that depth. Let the students know that now you are going to investigate one part of the ocean known as "The Open Ocean."

B. Present the PowerPoint *The Open Ocean*. Hand out the Student Worksheet *"The Open Ocean" Notes*. Read the directions and remind students of your expectations when it comes to note taking. [NOTE: The PowerPoint slides contain notes to guide the class discussion as you proceed through the presentation. The last few slides contain review questions to check for student understanding. Also, a 6 square graphic organizer form is provided as a sample. You may use any form of graphic organizer/note-taking format that you prefer.]

III. Understanding Bathymetry

A. Now that the class has been introduced to the parts or zones of the Open Ocean, tell them that while it is vast it is also very deep. Ask students if anyone knows how scientists measure the depths of the ocean. Answers may vary here. Explain to the class that bathymetry is mapping the ocean floor. Bathymetric maps are similar to topographic maps in that topographic maps show features and elevation above sea level and bathymetric maps show the depth and features of the ocean floor. Write the term on the board with its definition.

B. Show video clips about multibeam sonar, which is a tool that scientists use to map the ocean floor. Discuss reasons why scientists do ocean floor mapping. To access the video clips, go to NOAA's National Ocean Service Education website and click on the Movies and Podcasts link on the upper right hand side of the page: http://oceanservice.noaa.gov/education/seafloor-mapping/welcome.html

C. Have students identify and study the bathymetry of the Hawaiian Islands using Student Worksheet: *Bathymetry*. Read over the directions together and then allow students to work in pairs to answer the questions presented.

D. After the pairs complete the worksheet have volunteers share their answers with the class.

Extended Activities

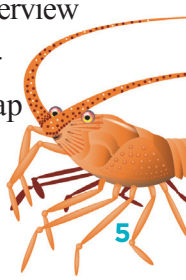
1. Allow students time to visit NOAA's National Ocean Service Education website: http://oceanservice.noaa.gov/education/seafloor-mapping/welcome.html
   This website has several activities, images, and video clips that students can interact with to learn how the sea floor is mapped using sonar techniques.

2. Access the following website: http://oceanexplorer.noaa.gov/edu/curriculum/section2.pdf for a deeper understanding of bathymetry and classroom activities to foster understanding with your students.

3. To give students a sense of the vastness of the ocean, have one or more students measure the length of the classroom. Write on the board "Epipelagic Zone is 650 feet." Ask students how many times the classroom would fit (if turned on its side) into this part of the ocean. Next, write on the board "1 mile = 5,280 feet." Assist students to identify a landmark that is one mile from the school. Ask students to calculate how many times they would have to walk to that location to reach the bottom of the benthopelagic zone (19, 685 feet). Adapted from: http://www.nationalgeographic.com/xpeditions/lessons/08/g35/seascolumn.html

4. Interview family members about the ocean. Ask questions such as, *What is it like? What do you see there?* Interview someone who has gone bottom fishing, or someone who goes sports fishing (e.g., billfish tournament).

5. Obtain a detailed bathymetric chart of your island, or of the Hawaiian island chain. Color-code the map to show the locations of inshore and open ocean waters.



LESSON 1

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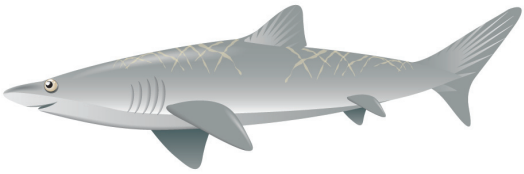


"The Open Ocean " Notes

Use this graphic organizer to take notes while viewing the PowerPoint.

Summary and other thoughts: What are the main points in the presentation? What questions did it make you think of?	

LESSON 1

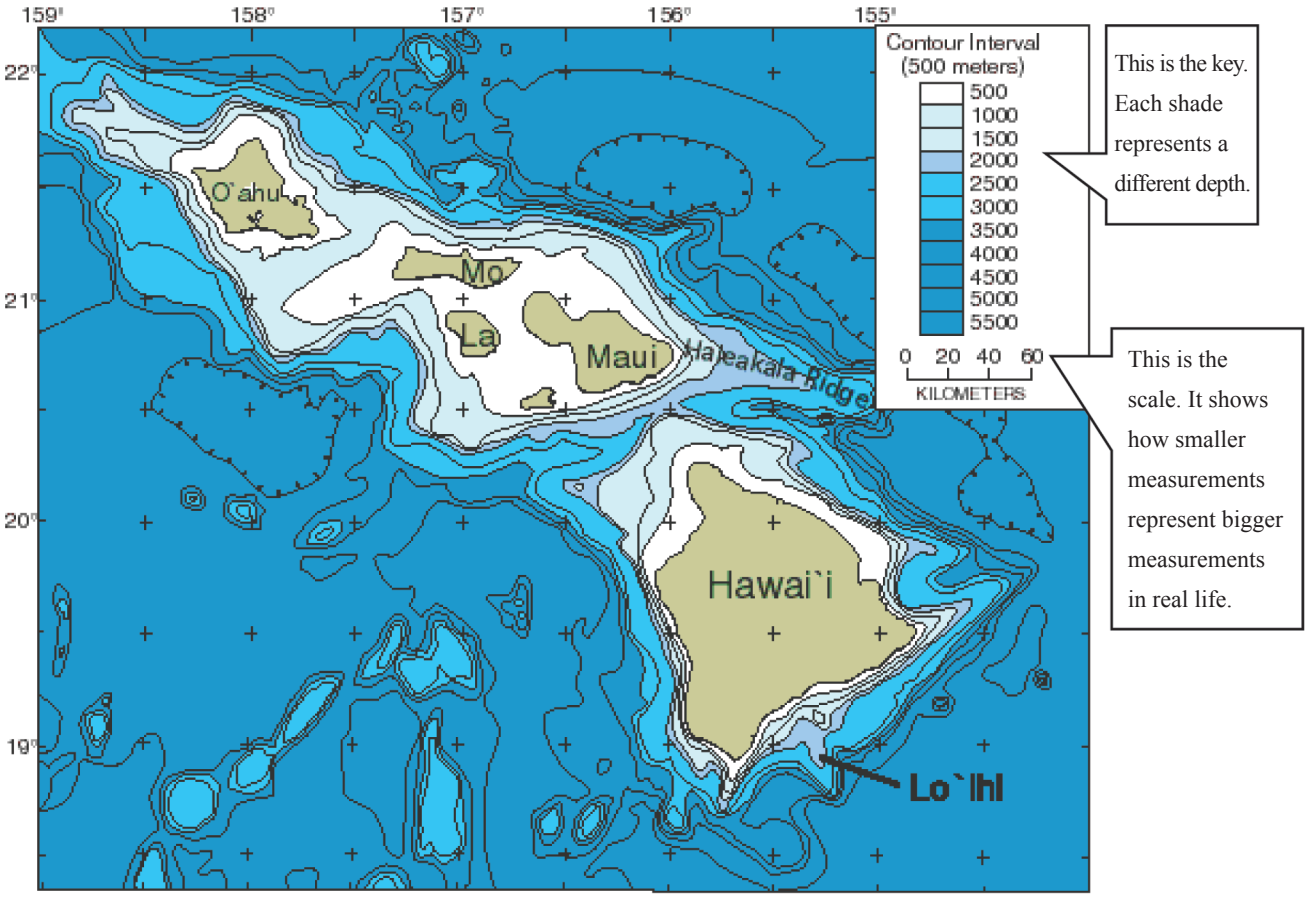
Name: _____ Date: _____

Bathymetry

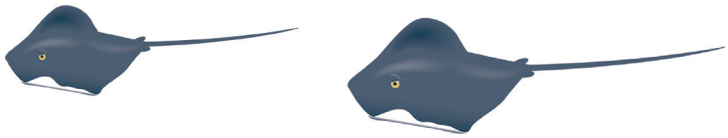
The map below is a *bathymetric* map. Bathymetry is mapping the ocean floor. Scientists collect data on the ocean floor's depth and unique features. They use this data to create maps and other tools that people can use. We read a bathymetric map by looking at the colors. Each color matches a certain depth. The color indicates the depth of that location. There is a key on the map that tells you all the colors and the depth each color represents. Sometimes, these are shades of one color and not different colors.

Source: http://hvo.wr.usgs.gov/volcanoes/haleakala/mauinui.html

Bathymetry of the Main Hawaiian Islands



Let's practice reading a bathymetry map!



1. Why do you think it would be important to know what the seafloor looks like?

2. Identify the depth of *inshore* (near land) and *open ocean* waters around Hawai'i.

   a. What is the largest depth measured by the map? _____

   b. Approximately how deep is *Lō'ihi* on the map? _____

   c. How deep is Haleakala Ridge (Give the range of depths)?_____

3. Another part of a map is the scale. It shows the reader how smaller measurements represent bigger, real life measurements. Now, let's practice using the scale to read a map! Find the island you live on. Approximately how far off shore would a boat need to travel to reach water that is 5,500 meters or deeper?

4. How are inshore waters different from open ocean waters (Use information from the presentation and map to answer this question.)?

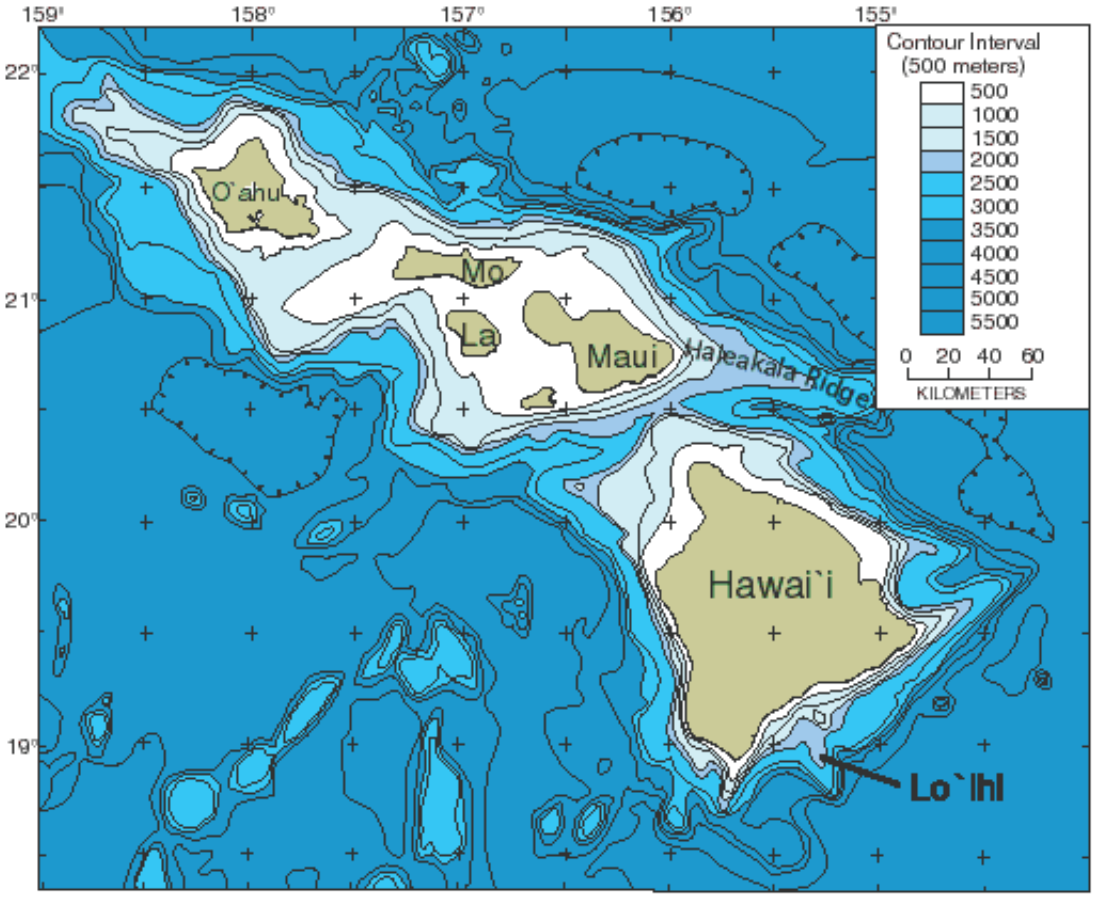
5. How is the open ocean environment important (Please explain your answer)?

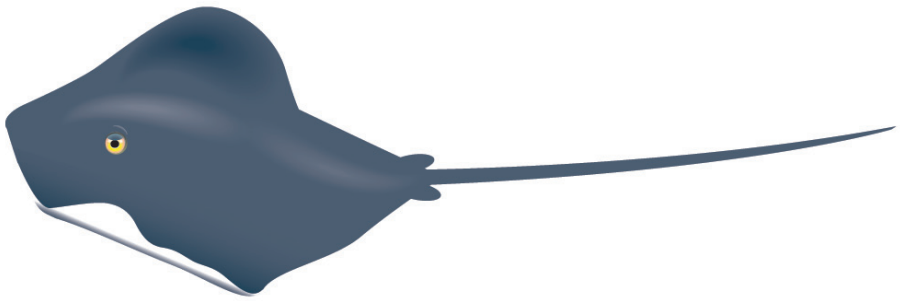
LESSON 1 - Teacher Reading

Bathymetry and Open Oceans

This map will prove useful when discussing the open ocean with students. Unlike the mainland, which consists of a long sloping continental shelf under the water, the Hawaiian Islands are steep-sided volcanoes, which give way to the open ocean. Using the following map, notice how quickly the contour interval changes in the open ocean from deep (5,500 meters or 18,045 ft. or more) to relatively shallow water, shown in white.

Source: http://hvo.wr.usgs.gov/volcanoes/haleakala/mauinui.html





LESSON 1 - Teacher Answer Key

Bathymetry

1. Why do you think it would be important to know what the seafloor looks like?

Student answers may vary. May include: avoiding rocks or coral while boating, etc.

2. Identify the depth of *inshore* (near land) and *open ocean* waters around Hawai‘i.

   a. What is the largest depth measured by the map? 5,500 meters (18,045 feet)

   b. Approximately how deep is *Lō‘ihi* on the map? 2,000 meters

   c. How deep is Haleakala Ridge (Give the range of depths)? 1,000-3,000 m (3,28-9,842 ft.)

3. Another part of a map is the scale. It shows the reader how smaller measurements represent bigger, real life measurements. Now, let’s practice using the scale to read a map! Find the island you live on. Approximately how far off shore would a boat need to travel to reach water that is 5,500 meters or deeper?

Generally speaking, not very far depending on where on each island they measure from.
[The idea of this question is to have students see that in Hawai‘i, we are not very far from the open ocean.]

4. How are inshore waters different from open ocean waters (Use information from the presentation and map to answer this question.)?

Student answers may vary. May include: change in water depth, type of organisms, (from PowerPoint) inshore is 100 meters from shore and open ocean is more than 300 meters from shore, etc.
[Note: students may think that this is a trick question because there isn’t a physical boundary between the two.]

5. How is the open ocean environment important (Please explain your answer)?

Student answers may vary. This question is meant for students to start thinking about the open ocean environment and how it impacts their lives.