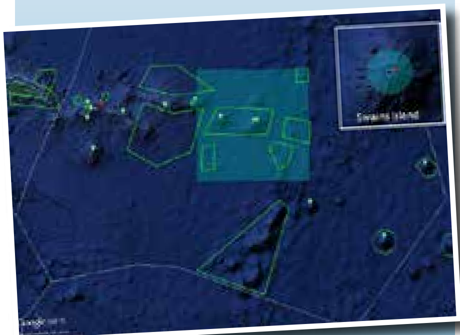


Image captions/credits on Page 2.

lesson plan

2017 American Samoa Expedition

Return to the Moat of Death

Focus
The Vailulu'u Seamount

Grade Level
6-8 (Earth Science)

Focus Question
What geological, biological and oceanographic processes have resulted in habitats observed on Vailulu'u Seamount?

Learning Objective
- Students will explain how geological, biological and oceanographic processes are involved with habitats observed on Vailulu'u seamount, and will discuss the time and spatial scales over which these processes operate.

Materials
Depends upon strategies offered for student educational products (see Learning Procedure Step 1d); students may be required to provide their own materials.

Audio-Visual Materials
- ❑ (Optional) Equipment to show images or video from 2017 American Samoa expedition website *http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/welcome.html*

Teaching Time
Two or three 45-minute class periods

Seating Arrangement
Groups of two to four students

Maximum Number of Students
30

Key Words
Vailulu'u
American Samoa
Volcano
Seamount
Moat of Death

Images from Page 1 top to bottom:
This Google Earth map showing the general expedition operating area. The green polygons are the priority mapping areas for the expedition. These areas were identified by NOAA partners, with input from American Samoa management agencies and from NOAA's 2017 Central Exploration Call for Input and regional workshops. Image courtesy of NOAA Office of Ocean Exploration and Research, 2017 American Samoa.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/background/plan/welcome.html

The ROVs are prepared for deployment on the aft deck of NOAA Ship *Okeanos Explorer*. The dual-body ROV is dedicated to the ship and includes the camera sled Seirios (left) and ROV *Deep Discoverer* (right). Both vehicles are outfitted with powerful lighting, high-definition imaging, and sensors to collect in situ environmental information on habitats being explored. *Deep Discoverer* is also equipped with a temperature probe, and two manipulator arms, coral cutters, and storage boxes for sample collections. Image courtesy of the NOAA Office of Ocean Exploration and Research.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/background/plan/media/rovsunrise.html

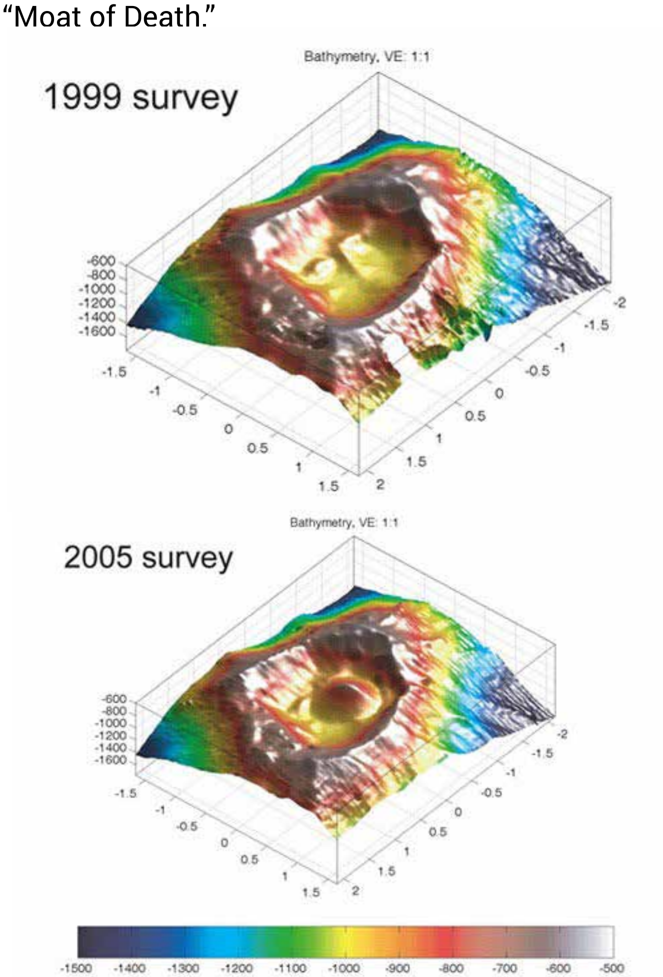
Swarms of cutthroat eels thriving in the crevices on the summit of Nafanua. Scientists dubbed this site "Eel City." Image courtesy of Vailulu'u 2005 Exploration, NOAA-OE.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/background/seamounts-life/media/eels.html

NOAA Ship *Okeanos Explorer* uses telepresence technology to transmit data in real time to a shore-based hub where the video is then transmitted to a number of Exploration Command Centers located around the country as well as to any Internet-enabled device. Access to the video combined with a suite of Internet-based collaboration tools allow scientists on shore to join the operation in real-time, and allows the general public to follow the expedition online. Image courtesy of the NOAA Office of Ocean Exploration and Research.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1605/background/plan/media/telepresence.html

Background Information

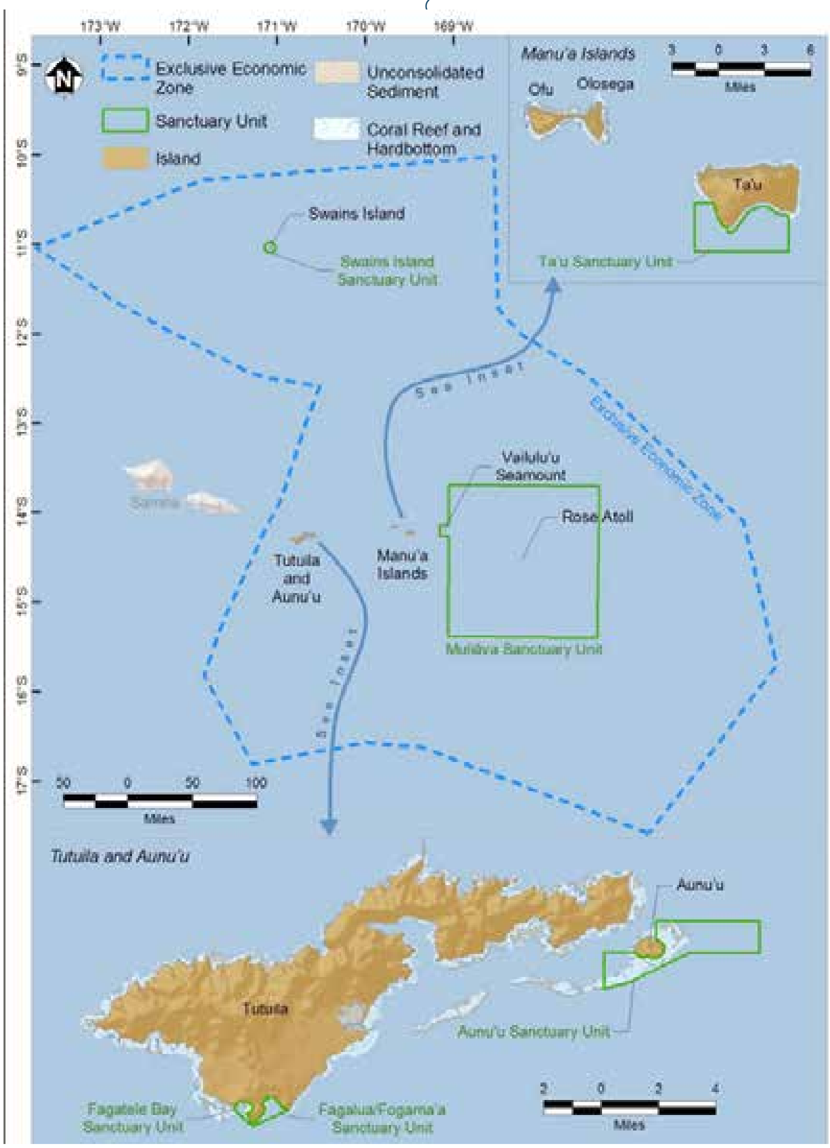
NOTE: Explanations and procedures in this lesson are written at a level appropriate to professional educators. In presenting and discussing this material with students, educators may need to adapt the language and instructional approach to styles that are best suited to specific student groups.

In March 2005, scientists participating in the Ocean Explorer Vailulu'u 2005 Expedition made an unexpected discovery. As they prepared to make their first submersible dive on the Vailulu'u underwater volcano, a multi-beam sonar image showed a submarine volcanic cone in the middle of the Vailulu'u caldera (the volcano's "crater") that had not been present when Vailulu'u was visited five years earlier. More surprises were in store for the scientists as they investigated the new cone (which they named Nafanua for the Samoan goddess of war), including features that they named "Eel City" and "Moat of Death."



Multi-beam maps showing the Vailulu'u crater when it was mapped in 1999, and again in 2005 when the map revealed a new volcanic cone, named Nafanua for the Samoan goddess of war. Continued growth could bring the summit close to the sea surface within decades. Image courtesy of Vailulu'u 2005 Exploration, NOAA-OE.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/background/seamounts-life/media/multibeam.html

Vailulu'u lies approximately 20 miles east of Ta'u Island in American Samoa. Like the Samoan Islands, Vailulu'u (and Nafanua) are believed to be the result of a hotspot; a sort of natural pipeline to reservoirs of magma in the Earth's mantle. Hotspots are relatively stationary, and produce volcanic eruptions on tectonic plates as the plates pass over the hotspot. Two well-known examples of hotspot volcanic activity are Yellowstone Park and the Hawaiian Islands (for more information, please see "Volcanic Islands and Seamounts in the Samoan Region" by Matt Jackson *http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/background/geology/welcome.html*).



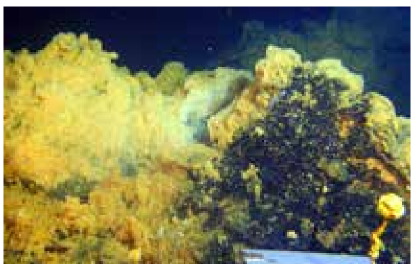
Management designations within Samoan Archipelago with Sanctuary Units Identified. The sanctuary is comprised of six protected areas, covering 13,581 square miles of nearshore coral reef and offshore open ocean waters across the Samoan Archipelago. Image courtesy NOAA.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/background/nmsas/media/nms-map.html

Vailulu'u is also located within the National Marine Sanctuary of American Samoa (NMSAS), one of 14 federally designated areas within United States waters that protect areas of the marine environment that are of special importance because of conservation, recreational, ecological, historical, cultural, archeological, scientific, educational, or aesthetic qualities. The NMSAS includes 13,581 square miles around the American Samoan islands and contains the only true tropical reef within the National Marine Sanctuary System (for more information, please see *http://americansamoa.noaa.gov*).

The Vailulu'u 2005 Expedition identified four major bottom habitats that are related to volcanic and hydrothermal activity, as well as the overall circulation of ocean water in the vicinity of the volcano.

Type I habitats are rocky substrates outside the crater that have no hydrothermal activity. These substrates are dominated by octocorals and sponges, with

Dense beds of soft octocorals, *Anthomastus sp.*, colonize the highest points around the rim of the volcano. Image courtesy of Vailulu'u 2005 Exploration, NOAA-OE.
http://oceanexplorer.noaa.gov/explorations/05vailuluu/media/hirez/octocoralbeds_hirez.jpg



The summit of Nafanua was covered with thick microbial mats, indicative of low-temperature venting. Image courtesy of Vailulu'u 2005 Exploration, NOAA-OE.
http://oceanexplorer.noaa.gov/explorations/05vailuluu/media/hirez/summit_mats_hirez.jpg

One of numerous dead fish that has succumbed in the acidic waters of the "moat of death" Note the small red polychaete worms that are grazing on and near the fish carcass. Image courtesy of Vailulu'u 2005 Exploration, NOAA-OE.
http://oceanexplorer.noaa.gov/explorations/05vailuluu/media/hirez/moat_of_death_hirez.jpg

Photomicrograph of a bright red polychaete collected from a fish carcass in the "moat of death" at a depth of 980m in Vailulu'u crater. These worms were the only living macroscopic organisms observed in this zone. Image courtesy of Vailulu'u 2005 Exploration, NOAA-OE.
http://oceanexplorer.noaa.gov/explorations/05vailuluu/media/hirez/redpolychaete_hirez.jpg

occasional echinoderms that include asteroids (starfish), crinoids (sea lilies) and ophiuroids (brittle stars). Highest densities of these organisms were found near the peak of the volcano. In this area, currents are stronger than in locations lower on the slope, and rapid water flow provides the best feeding conditions for filter and particulate feeders. Roaming predators and scavengers are also common in Type I habitats, and include eels and large octopi.

Type II habitats are found near the summit of Nafanua, and are characterized by periods of high turbidity alternating with periods of relatively clear water. It also has favorable conditions for the formation of iron oxide mats. Scattered low-temperature hydrothermal vents are common at this site, and are surrounded by massive bacterial mats and floating particles that are made mostly of iron oxide. The mats and particles are both the result of volcanic and hydrothermal activity, and suggest that this activity is a substantial source of chemical energy that contributes to primary production by microbes. Areas near the vents are inhabited by a large population of small cutthroat eels that occupy crevices in pillow lava flows. The chemistry and gut contents of the eels, however, indicates that these animals do not feed on the bacterial mats, but on small crustaceans that are brought to Nafanua's summit by the strong currents around the summit of Vailulu'u.

Type III habitats are found in a moat around Nafanua nicknamed the "Moat of Death." The water in this area is very turbid and highly acidic because of volcanic activity. These conditions are lethal to many ocean animals, and numerous carcasses of fishes, squid, and crustaceans were seen scattered over the seafloor. The exact cause of death is unknown, but is probably a combination of acidic conditions, low dissolved oxygen, and iron particles smothering gills. The only living animals seen in this area were bright red polychaetes that may have been feeding on bacteria from the rotting carcasses.

Type IV habitats are also found inside Vailulu'u crater. Toxic conditions are also found in these habitats, but toxic waters alternate with clean seawater that enters the crater through breaches in the crater wall. These varying conditions allow fish, crustaceans, sponges, and other animals to survive inside the crater, but may also trap fish and other midwater animals in the Moat of Death.

The geologic history of the Samoan Islands (which were formed by hotspot activity) and the recent emergence of Nafanua make it very likely that Vailulu'u will continue to erupt at intervals and eventually emerge from the sea surface as a new member of the Samoan Island chain. Not surprisingly, Samoan Island residents wonder whether such eruptions may have catastrophic impacts often associated with volcanic eruptions or possibly trigger tsunamis. Williams (2014) and Gisler *et al*. (2006) conclude that direct hazards from Vailulu'u eruptions are unlikely, with the possible exception of the threat to nearby shipping from volcanic debris. Submarine landslides are a more serious hazard, as these are known to trigger highly destructive tsunamis. Earthquakes may trigger tsunamis as well; the 2009 Samoan tsunami was caused by an earthquake resulting from subduction of the Pacific tectonic plate at its junction with the Australian tectonic plate. Holcomb and Searle (1991) state that "large landslides pose hazards to many islands, especially those composed of actively growing volcanoes."

The 2017 American Samoa Expedition was designed with input from many stakeholders, including American Samoa management agencies and regional workshops. Key areas of interest included more information about Vailulu'u since it is an active volcano, as well as surveys of bottomfish habitats. The overall goal of the expedition is to provide information needed to manage marine resources in American Samoa, with particular attention to management needs in NMSAS. Expedition objectives are to:

- Acquire data to support priority Monument science and management needs;
- Identify and map vulnerable marine habitats – particularly high-density deep-sea coral and sponge communities;
- Explore the diversity of benthic habitats and features (*e.g.*, seamounts, hydrothermal vents, deep-sea coral habitats, bottom fish habitats);
- Investigate the geologic history of Pacific seamounts, including potential relevance to plate tectonics and subduction zone biology and geology;
- Engage a broad spectrum of the scientific community and public in telepresence-based exploration; and
- Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

In this lesson, students will prepare educational presentations about the Vailulu'u volcano and its bottom habitats.

Learning Procedure

1. To prepare for this lesson:
   a. Review background information about the 2017 American Samoa expedition *http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/welcome.html*. You may also want to review "*Eel City and the Moat of Death: An Active Volcano on the Samoan Hotspot*," which is a summary of the 2005 Vailulu'u expedition. *http://oceanexplorer.noaa.gov/explorations/05vailuluu/welcome.html*

   b. Review "Vailulu'u Seamount, Samoa: Life and death on an active submarine volcano" *http://www.pnas.org/content/103/17/6448.full*

   c. Review the Multimedia Discovery Mission, Plate Tectonics (Lesson 1) *http://oceanexplorer.noaa.gov/edu/learning/welcome.html#lesson1* and Seamounts (Lesson 14) *http://oceanexplorer.noaa.gov/edu/learning/welcome.html#lesson14*, and decide whether you want to use these in your lesson plan.

   d. Decide what options you will offer students for creating their educational presentations, considering available time, materials, and other resources (for example, capability for students to create videos). Table 1 lists some ideas. Regardless of the specific options, it's always a good idea to include something like, "Your own idea, approved by the teacher" since some students may have unique ideas that could be quite successful.

   e. Consider the format in which students will present their products. Ideally, the audience will extend beyond other students in the classroom; perhaps a presentation to younger students, parents, or community members. A useful technique is to have students present first to their class, and then have the class select the top three or four for presentation to a larger audience. This approach elevates the importance of students' work beyond their own class, and often results in higher levels of engagement and effort.

2. Briefly introduce the NOAA Ship *Okeanos Explorer*, which is the only U.S. ship whose sole assignment is to

systematically explore Earth's largely unknown ocean for the purposes of discovery and the advancement of knowledge, and describe the objectives of the 2017 American Samoa expedition. You may want to show some images or videos from the expedition website *http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/welcome.html*.

3. Tell students that their assignment is to create a product that will educate other students and adults about Vailulu'u, to provide background knowledge that will help understand new information resulting from the 2017 American Samoa expedition. These products should explain:
   - What hotspots are, and how they are related to the Samoan Islands and Vailulu'u;
   - How hotspot activity is related to volcanic and hydrothermal processes at Vailulu'u;
   - The four benthic habitats identified at Vailulu'u, their importance to biological production and fisheries, and the interplay of volcanic, hydrothermal, oceanographic, and biological processes at these sites;
   - Hazards to humans associated with Vailulu'u, including the relative significance of volcanic eruptions and tsunamis.

   You may want to provide the following links to help students with their research. Full citations for these sources are provided in the "Other Resources" section):
   - *www.pnas.org/content/103/17/6448.full* (Staudigel, *et al.*, 2005. Vailulu'u Seamount, Samoa: Life and death on an active submarine volcano);
   - *www.tsunamisociety.org/251gislerkj.pdf* (Gisler et al., 2006. Two Dimensional Simulations of Explosive Eruptions of Kick-em Jenny and other Submarine Volcanoes); and
   - *http://oceanexplorer.noaa.gov/explorations/05vailuluu/welcome.html* (Young and Staudigel, 2005. Eel City and the Moat of Death: An Active Volcano on the Samoan Hotspot).

   In addition to your suggested list of options, you may also want to offer a couple of tips:
   - The first step in creating this type of product is to define your audience. Ask yourself, "Who is supposed to receive this message?" It may seem that the answer should be "everybody," but the problem with that answer is that different people communicate in different ways. Focusing your message toward a particular audience makes it more likely that your message will be understood.

- The next step is to choose your communication technique. This is where you can be really creative! Think about things that are likely to attract the attention of the audience you identified. Then think about unusual ways to present those things, because humans are much more likely to notice unusual events and objects than things that are familiar. Sometimes "unusual" just means that familiar things appear in unusual places. Look over the list of options, think about whether these give you some ideas of your own, then select the technique that you think is most likely to get the attention of your audience. Remember to consider your personal talents and interests as well. Perhaps you can sing, act, dance, play a musical instrument, paint, sculpt, enjoy making things, or have other skills. Think about ways to use these to help deliver your message. Your interest and enthusiasm are powerful tools for communication, because they are likely to attract the attention and interest of your audience.

You may want to show Table 1, or an edited version of the table, to help spark ideas.

4. Have students present their work to the rest of the class (and perhaps to larger audiences!), based on your plan developed in Step 1e. A rubric for evaluating these presentations is provided in Table 2.

5. Facilitate a class discussion about the geological, biological, and oceanographic processes that produce the habitats found on Vailulu'u seamount. Key processes include:
   - Volcanic activity that produces the overall physical form of the seamount and its surfaces (external slope, crater, Nafanua, lava flows, etc.), and also influences water chemistry;
   - Hydrothermal activity that produces iron oxide particulates and also influences water chemistry;
   - Strong currents around the seamount that bring fresh water into the Vailulu'u crater, and also provide a food source (plankton) for animals in the seamount habitats;
   - Toxic waters in the Moat of Death and elsewhere that kill animals inside the crater, which provides organic material for bacterial growth;
   - Primary production by microbes that use chemical energy from vented hydrothermal fluids to form bacterial mats.

Discuss the various time and spatial scales over which these processes operate. The Vailulu'u seamount is the result of volcanic processes that have operated over hundreds of years, but these processes can produce major changes, such as Nafanua, in much shorter time periods. Some processes, such as alternating high turbidity with relatively clear water, operate in a single day, and death of individual animals in the Moat of Death may happen in a matter of minutes. Similarly, the spatial scale of these processes may be very large, such as currents or volcanic activity; or quite small as is the case for physical habitats for eels in lava pillows.

6. Discuss the hazards that might result from volcanic activity at Vailulu'u. Lava flows and explosive eruptions are definitely hazardous to people in the immediate vicinity, but close proximity is unlikely when these events take place in deep water; unless you happen to be on a nearby boat. Tsunamis are a serious and well-known threat in American Samoa, but the most recent severe tsunamis have been the result of earthquakes caused by collision of tectonic plates. Simulation studies (Gisler *et al.*, 2006) suggest that underwater volcanic eruptions are not likely to be a direct cause of tsunamis. If these eruptions trigger underwater landslides, however, tsunamis may result. More information is needed to determine whether landslides are likely to result from volcanic eruptions at Vailulu'u.

The BRIDGE Connection

www.vims.edu/bridge/ – Enter "volcano" in the search bar to access resources about the underwater volcanoes.

The "Me" Connection

Movements of tectonic plates are involved with formation of Vailulu'u and Nafanua, as well as earthquakes and tsunamis. Have students write a brief essay discussing how tectonic plate movements might be of personal significance, and why it might be important to know more about them.

Connections to Other Subjects

English/Language Arts, Social Studies

Assessment

Participation in class discussions and educational products provide opportunities for assessment. A rubric for evaluating these presentations is provided in Table 2.

Extensions

Visit *http://oceanexplorer.noaa.gov/okeanos/explorations/explorations.html* for links to individual voyages of discovery by NOAA Ship *Okeanos Explorer*.

Other Relevant Lessons from NOAA's Ocean Exploration Program

The Volcano Factory (Grades 5-6)
from the 2006 Submarine Ring of Fire Expedition
[*http://oceanexplorer.noaa.gov/explorations/06fire/background/edu/media/ROF06.VolFactory.pdf*]

Focus: Volcanism on the Mariana Arc (Earth Science)

Students explain the tectonic processes that result in the formation of the Mariana Arc and the Mariana Trench; and explain why the Mariana Arc is one of the most volcanically active regions on Earth.

It's Going to Blow Up! (Grades 7-8)
from the 2006 Submarine Ring of Fire Expedition
[*http://oceanexplorer.noaa.gov/explorations/06fire/background/edu/media/ROF06.BlowUp.pdf]*

Focus: Volcanism on the Pacific Ring of Fire (Earth Science)

Students describe the processes that produce the Submarine Ring of Fire; explain the factors that contribute to explosive volcanic eruptions; identify at least three benefits that humans derive from volcanism; describe the primary risks posed by volcanic activity in the United States; and identify the volcano within the continental U.S. that is considered most dangerous.

Other Resources

The Web links below are provided for informational purposes only. Links outside of Ocean Explorer have been checked at the time of this page's publication, but the linking sites may become outdated or non-operational over time.

http://oceanexplorer.noaa.gov/okeanos/explorations/ex1702/welcome.html Web page for the 2017 American Samoa expedition Web page for the 2017 American Samoa expedition

http://oceanexplorer.noaa.gov/okeanos/edu/welcome.html – Web page for the NOAA Ship *Okeanos Explorer* Education Materials Collection

http://oceanexplorer.noaa.gov/edu/learning/welcome.html – Multimedia Discovery Missions, a series of 13 interactive multimedia presentations and learning activities that address topics ranging from Chemosynthesis and Hydrothermal Vent Life to Deep-sea Benthos

Fryer, P. 1992. Mud Volcanoes of the Marianas. *Scientific American* 266(2):46-52

Galen Gisler, G., R. Weaver, and M. Gittings. 2006. Two-Dimensional Simulations of Explosive Eruptions of Kick-em Jenny and other Submarine Volcanoes in A. Mercado-Irizarry and P. Liu, eds. Caribbean Tsunami Hazards, Proceedings of the NSF Caribbean Tsunami Workshop, 30 – 31 March 2004. Available online at: *www.tsunamisociety.org/251gislerkj.pdf*

Staudigel, et al., 2005. Vailulu'u Seamount, Samoa: Life and death on an active submarine volcano. Proc. Nat. Acad. Sci. 103(17):6448–6453. Available online at: *www.pnas.org/content/103/17/6448.full*

Young, C. and H. Staudigel, 2005. Eel City and the Moat of Death: An Active Volcano on the Samoan Hotspot. Available online at: *http://oceanexplorer.noaa.gov/explorations/05vailuluu/welcome.html*

Next Generation Science Standards

MS-ESS2 Earth's Systems

Performance Expectation

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

[Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

Science and Engineering Practices

Constructing Explanations and Designing Solutions

- Construct a scientific explanation based on valid and reliable evidence based on new evidence.

Disciplinary Core Ideas

ESS2.A: Earth's Materials and Systems

- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

Crosscutting Concepts

Scale Proportion and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Mathematics –

MP.2 Reason abstractly and quantitatively.

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Ocean Literacy Essential Principles and Fundamental Concepts

Essential Principle 1.
Earth has one big ocean with many features.

Fundamental Concept h. Although the ocean is large, it is finite, and resources are limited.

Essential Principle 2.
The ocean and life in the ocean shape the features of Earth.

Fundamental Concept e. Tectonic activity, sea level changes, and the force of waves influence the physical structure and landforms of the coast.

Essential Principle 6.
The ocean and humans are inextricably interconnected.

Fundamental Concept f. Much of the world's population lives in coastal areas. Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges).

Essential Principle 7.
The ocean is largely unexplored.

Fundamental Concept b. Understanding the ocean is more than a matter of curiosity. Exploration, experimentation, and discovery are required to better understand ocean systems and processes. Our very survival hinges upon it.

Fundamental Concept c. Over the last 50 years, use of ocean resources has increased significantly; the future sustainability of ocean resources depends on our understanding of those resources and their potential.

Fundamental Concept f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, physicists, animators, and illustrators. And these interactions foster new ideas and new perspectives for inquiries.

Send Us Your Feedback

In addition to consultation with expedition scientists, the development of lesson plans and other education products is guided by comments and suggestions from educators and others who use these materials. Please send questions and comments about these materials to: *oceanexeducation@noaa.gov*.

For More Information

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Acknowledgements

This lesson was developed and written for NOAA's Office of Ocean Exploration and Research (OER) by Dr. Mel Goodwin, PhD, Marine Biologist and Science Writer, Mt. Pleasant, SC. Design/layout: Coastal Images Graphic Design, Mt. Pleasant, SC.

Credit

Table 1
Some Communications Ideas

Blogs

Cartoons

CDs and DVDs

Computer screen savers

Dance

Ebooks

Electronic newsletter

Games and Competitions

Graffiti (in appropriate places, with permission!)

Letters

Musical performances

Newspapers

Performances

Photography

PowerPoint® or Keynote® or Prezi® presentations

Radio
(see *http://www.hobbybroadcaster.net/* for more information)

Scientific posters
(see *http://colinpurrington.com/tips/academic/posterdesign*;
http://www.ncsu.edu/project/posters/NewSite/)

Stories

Theatre
(plays, industrial theatre, ambush theatre, street theatre)

Videos

Wall Magazines
(periodical publications that appear in public places such as
bulletin boards or notice boards)

Table 2
Evaluation Rubric for Educational Products

Criteria	Expectations			
	Exceed	Meet	Approach	Does Not Meet
Required Elements	Includes all required elements as well as additional information	Includes all required elements	Includes most required elements	Includes few required elements
Accuracy	All information is accurate	At least 90% of information is accurate	At least 75% of information is accurate	Less than 75% of information is accurate
Quality of Presentation	Product is well-presented with no mistakes	Product is well-presented with few mistakes	Presentation has frequent mistakes and needs better preparation	Presentation is mostly ineffective and poorly planned
Creativity	Product concept is innovative or unique	Product concept is not new, but has innovative elements	Product concept is familiar and predictable	Product concept is very basic with little evidence of creativity
Collaboration (for groups)	Acts as a leader; consistently provides thoughtful ideas; encourages other members	Strong team member; often provides thoughtful ideas; usually encourages other members	Minimal participation, requires prompting; sometimes provides thoughtful ideas; sometimes encourages other members	Rarely participates; rarely provides thoughtful ideas; rarely encourages other members