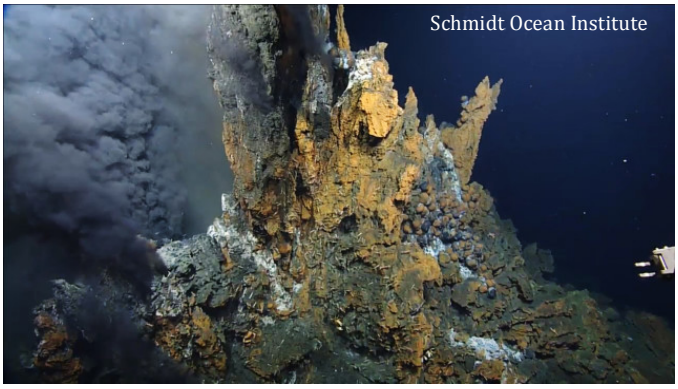
Lesson Plan: Virtual Vents Video Commentary



Focus: This classroom task is intended to allow students to explore hydrothermal vent communities through a variety of lenses and convey their understanding of the geologic processes, biology, and chemistry of the vent ecosystems by adding commentary to vent video.

Grade Level: 7-8 (Earth Science/Life Science) or 9-12 (Oceanography/Marine Science), depending on concept focus and depth of research

Learning Objectives: Students will be able to describe in detail earth's processes that form sea floor characteristics such as hydrothermal vents. Students will be able to describe the extreme environment of the hydrothermal vent in terms of temperature, chemistry, and geology. Students will identify organisms that live near hydrothermal vent systems and processes that allow those organisms to survive.

Materials: Students will need access to the internet for research and a video editing platform (iMovie) for creating the commentary clip.

Teaching Time: The entire task could take between 3-5 class periods (45-55 minutes each).

Background Information: The Niua Volcano is on the sea floor in the South Pacific near the boundary between the Pacific plate and the Indo-Australian plate. In this region, the rate at which the Pacific plate is colliding with the Indo-Australian plate is the fastest, creating one of the most active environments on the ocean floor. Due to their isolation, these hydrothermal vent fields are difficult to study and there are still many mysteries surrounding the biological, chemical, and geological relationships in these areas. By using Remotely Operated Vehicles (ROVs), scientists can bring detailed imagery and samples from the vents back to the surface to solve some of these mysteries.

Learning Procedure: This lesson makes use of written logs, photographs, and videos from other sources. Depending on the extent of internet access in your classroom, you may want to download and possibly duplicate some of these materials for student use. The activities described are designed as a series of projects undertaken by small groups or pairs of students.

1. Day 1: To prepare for this lesson, students will complete the ***Lesson Introduction worksheet*** while they watch the Introduction to Virtual Vents video (http://schmidtocean.org/cruise-log-post/video-1-introduction-virtual-vents/) and review the Virtual Vents cruise description (http://schmidtocean.org/cruise/virtual-vents-changing-face-hydrothermalism-revealed/).
2. Day 1-2: Students share reflection with class (either in a large group share during class time or via a class site/blog outside of class). Split the class up into pairs (or groups) based on their further exploration interest and allow for research time.
3. Day 2-4: Students research an area of interest relative to the Virtual Vents cruise and prepare a detailed commentary script (conveying their research outcomes) to 2 to 3 minutes of video clip from the Virtual Vents sampling dive (https://www.youtube.com/watch?v=zBDeIFANZA0). Potential video clips for commentary can be found on google drive (https://drive.google.com/drive/u/1/folders/0B36Jaez7BEygeXkwbXNfRG9lT00). Commentary key word suggestions include:

    A. Tectonics of the area, Formation of chimneys (keywords: asthenosphere, lithosphere, magma, tectonic plate, fault, subduction, seaping, heated fluids, dissolved minerals, precipitation)

B. Biology (keywords: bacteria, chemosynthesis, photosynthesis, primary production, amphipods, mussels, shrimp, clams, crab, tube worms)
C. Active black smoker (keywords: super-heated sea water, dissolved metals, volcanic gases, sulfide minerals, deposits)
D. Geology/Mining (keywords: sulfide deposits, precipitation, copper, gold, silver, zinc, risks)

Resources for research:

http://schmidtocean.org/cruise/virtual-vents-changing-face-hydrothermalism-revealed, http://oceanservice.noaa.gov/facts/vents.html, http://www.livescience.com/43220-subduction-zone-definition.html, https://www.volcanodiscovery.com/geology/subduction-zones.html, http://web.mit.edu/12.000/www/m2005/a2/finalwebsite/environ/geo/index.shtml, , http://www.pmel.noaa.gov/eoi/nemo/explorer/concepts/hydrothermal.html, http://oceanexplorer.noaa.gov/edu/learning/player, http://ocean.si.edu/ocean-videos/hydrothermal-vent-creatures, http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/ps_vents.html, http://www.amnh.org/explore/curriculum-collections/deep-sea-vents/hydrothermal-vent-formation/, http://www.whoi.edu/oceanus/feature/how-to-build-a-black-smoker-chimney, http://www.amnh.org/learn/pd/earth/pdf/black_smokers_incubators.pdf, http://www.whoi.edu/oceanus/feature/the-promise-and-perils-of-seafloor-mining, https://www.youtube.com/watch?v=xiEGIqwciVA, https://www.youtube.com/watch?v=D7jF1iZ1Klg

4. Day 5: Students finalize script (using rubric and peer review) and prepare video clip. Additional resources in the form of text, images, and/or video clips should be added to the ROPOS video clips to supplement and support the script discussion. Students record commentary along with video clip. Video commentary should provide an introduction to the Niau crater area, research results, and credits including student names, Schmidt Ocean Institute, and a list of resources used.
5. Extension: Share clips with class and allow for peer review and suggested edits as needed prior to sharing with larger community.

Script Student Outcomes: As a group, students will produce a script that conveys research outcomes. The script should include speaking parts of all group members and contain a thorough summary of research findings directly referring to images in the video. Information should be relevant to the video clip and thorough in addressing key word concepts. Students will peer review scripts using the below rubric prior to recording.

Group Script	**4**	**3**	**2**	**1**
Content (4 pts)	The information contained is thorough, accurate, and relevant to the video clip. Key words and concepts are addressed thoroughly.	Most of the information presented is thorough, accurate, and relevant to the video clip. Key words and concepts are addressed.	The presentation reflects some research, may have some errors or lack relevance.	Little research is shown and/or information is inaccurate and not relevant.
Length and Transitions (4 pts)	The script is typed, includes content to span the entire 2-3 minute video clip, and includes transitions between speakers and no grammatical errors.	The script is typed, may be slightly too long or too short, includes transitions and almost no grammatical errors.	The script is typed, but is noticeably too long or too short. Transitions are unclear and/or grammatical errors are apparent.	The script is not typed, is incomplete, and/or contains glaring grammatical errors.

Video Commentary Student Outcomes: As a group, students will produce a short video including a script, ROPOS dive video, and supplementary text, images, or video clips in order to highlight the unique hydrothermal vent environment. Video should include a brief introduction to the area, imagery that supports key words and concepts discussed in script, smooth transitions, and credits including the students' names, Schmidt Ocean Institute, and any resources used.

Video & Commentary	**4**	**3**	**2**	**1**
Video Imagery (Group) (4 pts)	A substantial amount of Niua crater video is included. Smooth transitions to supplementary media that aids in conveying research ideas. Includes complete introduction and credits.	Niua crater video and relevant supplementary media is included in the video along with introduction and credits.	Video missing some key points or imagery reflecting key words. Added media somewhat supports research findings. Introduction or credits are incomplete.	Video is incomplete or added media does not support research results. Missing introduction or credits.
Flow (Group) (4 pts)	Commentary appears well rehearsed with smooth transitions between group members.	Commentary appears somewhat rehearsed with semi-smooth transitions.	Commentary does not appear rehearsed and/or has few transitions.	Commentary has no flow and there are moments of silence.
Contribution (Individual) (4 pts)	As a group member, I contributed substantially to the group commentary and video production.	As a group member, I contributed to the group commentary and video production.	I contributed somewhat to the project.	I did not do my share of the work.

Next Generation Science Standards:

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.]

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples of include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]

National Science Standards:

Content Standard C: Life Science • Structure and function in living systems • Populations and ecosystems • Diversity and adaptations of organisms

Content Standard D: Earth and Space Science • Structure of the Earth system

Content Standard F: Science in Personal and Social Perspectives • Populations, resources, and environments

Ocean Literacy Essential Principles and Fundamental Concepts: Essential Principle: The Earth has one big ocean with many features. • *Fundamental Concept b.* An ocean basin's size, shape and features (such as islands, trenches, mid-ocean ridges, rift valleys) vary due to the movement of Earth's lithospheric plates. Earth's highest peaks, deepest valleys and flattest vast plains are all in the ocean.

Essential Principle: The ocean and life in the ocean shape the features of the Earth. • *Fundamental Concept e.* Tectonic activity, sea level changes, and force of waves influence the physical structure and landforms of the coast.

Essential Principle: The ocean makes Earth habitable. • *Fundamental Concept b.* The first life is thought to have started in the ocean. The earliest evidence of life is found in the ocean.

Essential Priniciple: The ocean supports a great diversity of life and ecosystems.

- *Fundamental Concept b. Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.*
- *Fundamental Concept c. Some major groups are found exclusively in the ocean. The diversity of major groups of organisms is much greater in the ocean than on land.*
- *Fundamental Concept d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, preda- tor-prey dynamics and energy transfer) that do not occur on land.*
- *Fundamental Concept g. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.*

Essential Priniciple: 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 great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.*
- *Fundamental Concept b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and pro- cesses.*
- *Fundamental Concept d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.*
- *Fundamental Concept f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.*