



Surfacing Ocean Mysteries

Grade Level

5–8 or higher

Timeframe

45 minutes or more

Materials

- Computer, projector and screen
- Text documents (available to download)
- Student access to the internet for research

Key Words

Phenomenon, ecosystems, expeditions, exploration, geology, shipwrecks

Standards

NGSS: Will vary; can include [MS-LS2-4](#). [LS2.C](#).
CCSS: [W.6.10](#). [SL.6.4](#).
Ocean Literacy Principles: [7](#).
Details at end of lesson



A diver explores a shipwreck at Monitor National Marine Sanctuary.
Photo: NOAA

Activity Summary

Students explore phenomena observed at national marine sanctuaries or monuments. They choose a phenomenon to research and prepare a presentation or poster to share with the class. Suggested phenomena are listed or students can select a research topic of their choice, based on what they learn from sanctuary or expedition websites. They investigate reasons for ocean exploration and benefits to humans. They discover that most of the ocean is unexplored and that exploration is critical for protecting life on Earth and finding new resources.

Learning Objectives

Students will be able to:

- Research and describe orally and in writing a marine phenomenon and argue from evidence why their chosen topic is significant.
- Demonstrate skills in research, organizing information and presenting it to others.
- Explain how their topic relates to the idea that “the ocean is largely unexplored.”
- Explain the importance of ocean exploration, including the benefits to humans and that knowledge helps protect ocean health for future generations.

Funding support provided by:

National Geographic Society

&



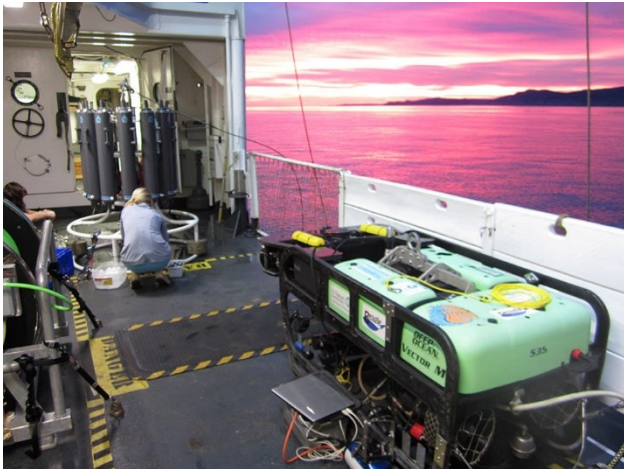
**National
Marine Sanctuary
Foundation**

Background Information

The ocean is the largest unexplored place on Earth. The next generation of explorers and researchers have boundless opportunities for discovery, innovation and investigation.

Exploring Sanctuaries

National marine sanctuaries are a network of underwater areas in the ocean and Great Lakes that protect America's most iconic natural and cultural marine resources. The sites of our national marine sanctuary system are hubs for science, exploration and education. At any given time, researchers are in sanctuaries exploring the deep, monitoring kelp forests, tracking coral reef health, studying undersea volcanoes, documenting historic shipwrecks and much more.



A remotely operated vehicle (ROV) ready to explore deep-water ecosystems at Channel Islands National Marine Sanctuary. Photo: NCCOS Charleston Lab

Why Explore the Ocean?

Despite the fact that the ocean covers approximately 70% of Earth's surface and plays a critical role in supporting life on our planet, from the air we breathe and the food we eat to weather and climate patterns, our understanding of the ocean remains limited.

Exploration is conducted by NOAA teams who also work with Ocean Exploration Trust

(*Nautilus Live*), the Schmidt Ocean Institute and other partners. These organizations share their discoveries through a wealth of videos, photos and stories, as well as live broadcasts so we can all experience the mysteries of the ocean. On every expedition, scientists explore and observe exciting phenomena that help us better understand the biological and physical processes in the marine environment.

Science & Technology Make It Possible

Ocean exploration is about making discoveries, searching for things that are unusual and unexpected. As the first step in the scientific process, the rigorous observations and documentation of biological, chemical, physical, geological and archaeological aspects of the ocean gained from exploration, set the stage for future research and decision-making.

Through ocean exploration, scientists collect data and information needed to address both current and emerging science and management needs. Exploration helps to ensure that ocean resources (e.g., fish species) are not just managed, but managed in a sustainable way, so those resources are around for future generations to enjoy.

Surfacing Opportunities

Unlocking the mysteries of ocean ecosystems can reveal new sources for medical therapies and vaccines, food, energy and more as well as inspire inventions that mimic adaptations of deep-sea animals. Information from ocean exploration can help us understand how we are affecting and being affected by changes in Earth's environment, including changes in weather and climate. Insights from ocean exploration can help us better understand and respond to earthquakes, tsunamis and other hazards.

The challenges met while exploring the ocean can provide the impetus for new technologies and engineering innovations that can be applied

in other situations, allowing us to respond more effectively in the face of an ocean crisis, such as an oil spill. And, ocean exploration can improve ocean literacy and inspire young people to seek critical careers in science, technology, engineering and mathematics.



Deep-sea octopus in the brooding position at Davidson Seamount, Monterey Bay National Marine Sanctuary. Photo: NOAA/Ocean Exploration Trust

Learn more:

NOAA Expeditions:
<https://oceanexplorer.noaa.gov/explorations/explorations.html>

NOAA Ocean Exploration:
<https://oceanexplorer.noaa.gov>

Nautilus Live / Ocean Exploration Trust:
<https://nautiluslive.org>

Monterey Bay Aquarium Research Institute (MBARI): <https://www.mbari.org>

Ocean Research & Conservation Organization (ORCA): <https://www.teamorca.org>

Schmidt Ocean Institute:
<https://schmidtocean.org>

Vocabulary	
Hydrothermal vent	An opening on the seafloor that emits hot, mineral-rich solutions
Methane seep	A place in the ocean where the gas methane escapes from cracks or fissures in the ocean floor
Microbial mat	A multi-layered sheet of microorganisms, generally bacteria. Microbial mats grow mostly on submerged or moist surfaces.
Phenomenon	Observable events that occur in the universe and that we can use our science knowledge to explain or predict
Seamount	An underwater mountain that rises at least 1,000 meters (3,300 feet) above the surrounding seafloor. Formed through volcanic activity

Preparation

- Prepare to show one or more videos listed below.
- Print copies of the “Investigating Ocean Mysteries” handout, one per student.
- Print copies of the “Ocean Mysteries Presentation” rubric, one per student.
- Arrange for students to have access to online research: a computer lab, tablets, etc.

Procedure

Engage

- Show students a short video clip of a phenomenon observed at a national marine sanctuary. You might choose to mute the sound to add to the mystery. Options include:

- Mysterious Purple Orb at Channel Islands National Marine Sanctuary: <https://nautiluslive.org/video/2016/07/26/mysterious-purple-orb>
- Octopus Wonderland at Davidson Seamount in the Monterey Bay National Marine Sanctuary: <https://nautiluslive.org/video/2020/10/27/octopus-wonderland-return-davidson-seamount>
- Fossilized Face Ancient Beaked Whale Skull at Papahānaumokuākea Marine National Monument: <https://nautiluslive.org/video/2021/12/02/fossilized-face-ancient-beaked-whale-skull-found-papahanaumokuakea-marine-national>
- Other video options: <https://nautiluslive.org/photos-videos>
- Write on the board or project the following questions and ask students:
 - What phenomenon is being investigated?
 - Ask students to share their ideas in a class discussion. If needed, clarify that a phenomenon is an observable event that occurs in the universe and that we can use our science knowledge to explain or predict.
- Tell students that they will be investigating ocean mysteries of their choice today.

Explore

- Pass out the “Investigating Ocean Mysteries” handout, one per student, or distribute it electronically. Tell them that the list shows interesting phenomena being investigated at one or more national marine sanctuaries or monuments. Ask them to think about which topics they would like to learn more about and put a check mark next to their selections. Then ask them to rank their choices from 1–5 with numbers to the left of the check boxes. Or they may select their own topic they’d like to research.
- Project a map of the sanctuaries and monuments from the website so students can see the locations of sanctuaries: <https://sanctuaries.noaa.gov>. If students are unfamiliar with marine sanctuaries and monuments, tell them they are a network of underwater areas in the ocean and Great Lakes that protect America's natural and cultural marine resources. Tell them that scientists conduct research in these areas to understand physical and geologic processes as well as the organisms that live there, such as corals, marine mammals and fish. Tell students they can explore the sanctuary websites if they’d like to get more ideas of mysteries being investigated, which also include shipwrecks and other types of marine archaeology.
- Ask students to tell you their first choice of topics, or a second or third choice if classmates have selected those. They will share their discoveries in a short class presentation or poster. Answering the questions on page two of the handout will prepare them for their project.
- Suggest to students that they can find information about their assigned topic in the following ways:
 - Visit <https://sanctuaries.noaa.gov> and click Explore > Science.
 - Visit NOAA’s Ocean Exploration website: <https://oceanexplorer.noaa.gov/welcome.html>

- To locate expeditions within a sanctuary or monument, use the search box and type the name of a sanctuary or monument in quotation marks, e.g., “Cordell Bank National Marine Sanctuary” or simply “sanctuary.”
 - Mission Logs and Background Information on expedition pages provide a wealth of information on phenomenon.
 - Students can use videos taken during E/V *Nautilus* expeditions as part of their research: <https://nautiluslive.org/photos-videos>
 - To locate expeditions within a sanctuary or monument, use the search box as noted above.
 - You might share an example video with students and work through some of the questions on the handout together. A good option is “New Sponge Species Found in Cordell Bank National Marine Sanctuary”: <https://nautiluslive.org/video/2018/05/29/new-sponge-species-found-cordell-bank-national-marine-sanctuary>
 - Read news stories about discoveries, as reported in the media: <https://oceanexplorer.noaa.gov/news/oceanexplorationnews>
- Watch videos about sanctuaries at <https://www.youtube.com/@sanctuaries>
- Visit Sanctuaries Live to watch expedition livestreams <https://sanctuaries.noaa.gov/live>
- Pass out the “Ocean Mysteries Presentations” rubric so students know how they will be assessed. Tell students they should fill in the “Your Score” column and give it to you when they are ready to present to the class.
- Circulate through the class while they are working. You can point students to the following videos if they need help:
 - Deep-sea corals: <https://nautiluslive.org/album/2020/11/20/exploring-deep-sea-corals-olympic-coast-national-marine-sanctuary>
 - DNA from the seafloor: <https://oceanexplorer.noaa.gov/explorations/22blue-econ-biotech/features/dna/dna.html>
 - Hydrothermal vent at Vailulu'u Seamount: <https://nautiluslive.org/video/2019/08/03/bubbling-vents-and-colorful-chimneys-volcanic-vailuluu-seamount>
 - Life on Voyager Seamounts: <https://nautiluslive.org/album/2021/12/13/abundance-life-slopes-voyager-seamounts>
 - Methane seeps: <http://nautiluslive.org/blog/2020/10/05/seeps-part-ocean-and-society>
 - Microbial mats: <https://nautiluslive.org/video/2020/10/22/exploring-microbial-mats-quinault-canyon>
 - Octopus garden: <https://nautiluslive.org/video/2020/10/27/octopus-wonderland-return-davidson-seamount>

- Quicksands archaeology: <https://oceanexplorer.noaa.gov/explorations/21quicksands/welcome.html>
- Rocky reef habitats: <https://nautiluslive.org/video/2020/11/04/rocky-reefs-and-sponge-gardens-southern-california>
- Shipwreck Ironton – Thunder Bay: <https://nautiluslive.org/blog/2023/03/29/frozen-time-national-marine-sanctuary-researchers-discover-lost-shipwreck-ironton>
- Shipwreck – The Monitor: <https://www.youtube.com/watch?v=3gdC4VLv77o>
- “Sponge garden”: <https://nautiluslive.org/video/2020/11/19/sampling-glass-sponges-olympic-coast-national-marine-sanctuary>
- Whale fall: <https://nautiluslive.org/video/2020/10/17/return-davidson-seamount-whale-fall>
- “Yellow brick road” rock formation: <https://nautiluslive.org/video/2022/04/29/follow-yellow-brick-road-geologic-features-liliuokalani-ridge-seamounts>
- Support students with finding resources to complete their presentation or poster.
 - Remind students to use the websites listed above to locate the most relevant and reputable information related to their topic.
 - Circulate amongst students to answer questions and assist them with finding resources to support their learning.

Explain

- Ask students to present to the class about their phenomenon or do a gallery walk through posters to learn about each other’s topics. Ask the class to record interesting points from the presentations in science notebooks.
- Ask students the following questions:
 - How much of the ocean do you think has been explored?
 - Why do you think it is important to explore the ocean?
- Discuss student ideas. If they don’t bring up the following points, help students understand:
 - Vast areas of the ocean are unmapped to high resolution, unobserved and unexplored. Most of Earth’s ocean floor has never been seen by human eyes. Even within marine sanctuaries there are many mysteries to be solved.
 - Scientists estimate that approximately 90% of ocean species have yet to be classified. Scientists regularly identify new species on expeditions. Learn more: <https://oceanservice.noaa.gov/facts/ocean-species.html>
 - Through ocean exploration, NOAA and its partners collect data and information needed to address both current and emerging science and management needs. Exploration helps

to ensure that ocean resources are not just managed, but managed in a sustainable way, so those resources are around for future generations to enjoy.

- For example, deep-sea corals, which grow very slowly, are susceptible to damage by some types of fishing gear. Knowing where significant deep-sea coral communities are located is the first step in protecting them.
- Images and samples collected during deep-sea expeditions contributed to the expansion of national marine sanctuaries to protect coral habitat. Learn more: <https://coastalscience.noaa.gov/science-areas/coral-ecosystem/deep-sea-corals>
- Almost 50% of the medicines we use today come from nature. Many marine plants and animals are producers of natural substances that might be used as medicine. During some ocean exploration expeditions, scientists are looking for new microorganisms, sponges, corals and other marine organisms rich in natural products that can be turned into pharmaceutical products or used as biomedical research tools. Learn more: <https://oceanexplorer.noaa.gov/facts/natural-product.html>

Enrich/Extend

- Ask students to create a model of their selected phenomenon. It could be a diorama, constructed in clay or paper or a drawing. They should label and explain the parts of their models.
- Show students the NOAA video “Why Explore?”: https://oceanexplorer.noaa.gov/video_playlist/extras-why.html. Ask students to summarize the main points of the video and add any additional ideas they have.

Evaluate

- Evaluate student presentations or posters according to the rubric.
- Review science notebooks and any additional products students created.
- Evaluate student contributions to discussions.

Education Standards	
Next Generation Science Standards	<p>Will vary; examples students can meet for relevant topics:</p> <p>Ecosystems: Interactions, Energy, and Dynamics</p> <ul style="list-style-type: none"> • MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. <p>LS2.C: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.</p> <p>Science and Engineering Practices:</p> <ul style="list-style-type: none"> • Engaging in Argument from Evidence <p>Crosscutting Concepts:</p> <ul style="list-style-type: none"> • Cause and Effect • Systems and System Models

Education Standards	
Common Core State Standards	Writing: W.6.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. Speaking and Listening: SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes.
Ocean Literacy Principles	7. The ocean is largely unexplored. (a, b)

Additional Resources

“Deep Ocean Education Project.” NOAA Ocean Exploration/*Nautilus* Live/Schmidt Ocean Institute: <https://deepoceaneducation.org>

“Ocean Exploration” lesson. National Geographic Society: <https://education.nationalgeographic.org/resource/ocean-exploration-activity>

“Ocean Exploration Educational Materials By Theme.” NOAA Ocean Exploration: <https://oceanexplorer.noaa.gov/edu/themes/welcome.html>

For More Information

This lesson was developed by NOAA’s Office of National Marine Sanctuaries. This lesson is in the public domain and cannot be used for commercial purposes. Permission is hereby granted for the reproduction, without alteration, of this lesson on the condition its source is acknowledged. When reproducing this lesson, please cite NOAA’s Office of National Marine Sanctuaries as the source, and provide the following URL for further information: <https://sanctuaries.noaa.gov/education>. If you have any further questions or need additional information, email sanctuary.education@noaa.gov.

This product was developed with funding support from the National Geographic Society and the National Marine Sanctuaries Foundation <https://marinesanctuary.org> in collaboration with Rick Reynolds, M.S.Ed. and Krista Reynolds, MLIS, M.Ed. of Engaging Every Student.