Ocean Explorers: Unlocking Mysteries

Grade Level

5–8 or higher

Timeframe

50 minutes or more

Materials

- Computer, projector and screen
- Visual materials (all available to download)
- Text documents (all available to download)

Key Words

Careers, exploration, marine archaeologist, marine biologist, microbiologist, multibeam sonar, oceanographer, remotely operated vehicle (ROV), research, sonar, submersible, technology

Standards

NGSS: Will vary
CCSS: W.6.10. SL.6.4.
Ocean Literacy Principles: 6, 7.
Details at end of lesson

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National Geographic Society

&

National Marine Sanctuary Foundation

A Native Hawaiian cultural practitioner sounds the pū (conch shell trumpet) at Nihoa Island, Papahānaumokuākea Marine National Monument. Today's ocean explorers sail in the wake of discoveries from Native Hawaiians and other Indigenous peoples. Photo: Jamie Makasobe

Activity Summary

Students investigate an ocean explorer and their work in and around national marine sanctuaries or monuments. Students research and prepare a project in a medium of their choice to share with the class. They reflect on the methods scientists use and challenges of exploring the ocean. Suggested explorers are listed or students can select one of their choice. Students will realize that we know very little about the ocean, with many mysteries yet to be investigated.

Learning Objectives

Students will:

- Research and describe orally and in writing an ocean explorer and their work.
- Explain the processes explorers and scientists use to gain and share knowledge in their field of study.
- Demonstrate skills in research, organizing information and presenting it to others.
- Argue from evidence why their explorer's work is important and how it relates to the idea that "the ocean is largely unexplored."

Background Information

The ocean is the last great frontier on Earth, with vast parts of it yet to be explored. The next generation of explorers and researchers will find great opportunities for discovery, innovation and investigation.

Exploration helps to ensure that ocean resources are well-managed and more likely to benefit future generations. For example, the fish that live on coral reefs are a significant food source for people worldwide. In the United States, about half of all federally managed fisheries depend on coral reefs.

Deep-sea exploration is just as critical. Unlocking the mysteries of deep-sea ecosystems can reveal new sources of medical drugs, food, energy resources and other products. Information from deep-ocean exploration can help predict earthquakes and tsunamis and help us understand how we are affecting and being affected by changes in Earth's atmosphere, climate and ocean chemistry.

National Marine Sanctuaries

National marine sanctuaries and monuments are a network of underwater areas in the ocean and Great Lakes that protect America's most iconic natural and cultural marine resources. They 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 and more.

Many Types of Explorers

Ocean explorers are not only oceanographers and marine biologists. Ocean exploration requires people and organizations in different disciplines of science, technology, engineering, mathematics and traditional knowledge. In addition to researchers from all fields, expeditions employ captains, remotely operated vehicle (ROV) pilots, mapping experts, video engineers and data engineers. Interactions between people from different fields foster new ideas and new perspectives for inquiries.

Ocean explorer/communication fellow Malanai N. Kāne Kuahiwinui; Screenshot from Nautilus Live video: https://nautiluslive.org/video/2022/04/26/learn-hawaiian-ocean-explorer-malanai

The Scientific Process

Scientists use the scientific process to conduct their work. They make observations, ask a question about what they observe, form a hypothesis to explain their observations, design an experiment to test the hypothesis, collect and analyze data, revise or support their explanation and report their findings. This is a continuous process that may not follow a linear path.

Because our ocean is largely unknown, explorers are often focused on the first stages of conducting scientific investigations while on expeditions. They make observations, ask questions and may form hypotheses. For example, they may gather data about the environment and record the species that live there and may suggest why organisms live in certain environments. Ocean exploration generally creates more questions than answers, and explorers set the stage for other scientists to conduct experiments and test hypotheses.

The Power of Self-directed Learning

Most students are engaged by personal stories and tales of discovery and exploration. The

research and self-guided projects in this lesson tap into this natural affinity for learning about inspiring people and the technologies they use to do their work.

Learn more:

NOAA Ocean Exploration Expeditions: https://oceanexplorer.noaa.gov/explorations/explorations.html

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

"Deep Sea Research." Ocean Research & Conservation Organization (ORCA): https://www.teamorca.org/deep-sea

Schmidt Ocean Institute: https://schmidtocean.org

Nautilus Live/Ocean Exploration Trust expeditions: https://nautiluslive.org/expeditions

Vocabulary	
Bioluminescence	The production and emission of light by a living organism
Marine archaeologist	A person who studies past human cultures with an emphasis on how humans interacted with the world's ocean basins, lakes and river systems
Marine biologist	A scientist who studies organisms that live in the sea
Microbiologist	A scientist who studies microscopic life forms and processes
Multibeam sonar	A tool that uses sound waves to map the seafloor and detect objects in the water column or along the seafloor: Multibeam sonar sends out multiple sonar beams all at once in a fan-shaped pattern.
Oceanographer	A scientist who studies the ocean: Oceanographers study marine life and ecosystems, plate tectonics and the geology of the seafloor, ocean circulation and the chemical and physical properties of the ocean.
Okeanos Explorer	The only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge about the ocean. The ship's exploratory mission is coordinated by NOAA Ocean Exploration.
Remotely operated vehicle (ROV)	A submersible robot connected to a ship with a tether
Sonar	A tool that uses sound waves to map the seafloor and detect objects in the water column or along the seafloor
Submersible	An underwater robot that is deployed from a ship to the sea, where it records and collects information from the ocean for scientific analysis

Preparation

- Prepare to show one or more videos listed below.
- Print copies of the "Ocean Explorers: Unlocking Mysteries" handout, one per student.
- Print copies of the "Ocean Explorers Project" handout, one per student.
- Arrange for students to have access to online research: a computer lab, tablets, etc. If possible, you could also arrange for students to visit a library and have the support of a librarian and/or technology specialist for their research projects.

Procedure

Engage

- Hold up a model of an interesting marine organism if you have one, or show students photos. Good examples are in the "Bioluminescent Ocean" (4:00) video from NOAA's Ocean Today: https://oceantoday.noaa.gov/bioluminescentocean. Share a couple of fascinating, related facts and ask students to think about how we were able to learn about the organism(s). Many more images are at:
    - NOAA Ocean Exploration: https://oceanexplorer.noaa.gov/image-gallery/welcome.html.
    - Earth Is Blue: https://sanctuaries.noaa.gov/earthisblue.html#photos
- Show students one or more of the following videos—or clip(s)—that highlight national marine sanctuaries and monuments and how our ocean and Great Lakes are largely unexplored:
    - "Stories from the Blue: Jill Heinerth" (5:59): https://sanctuaries.noaa.gov/earthisblue/wk283-stories-from-the-blue-jill-heinerth.html
    - "Thunder Bay National Marine Sanctuary 360˚ Shipwreck Alley" (3:07): https://sanctuaries.noaa.gov/vr/thunder-bay/shipwreck-alley
    - "Adventures of a Maritime Archaeologist" (0:44): https://oceantoday.noaa.gov/ma_intro
- Ask students to think about these questions, which you can write on the board or project:
    - What types of professionals explore and share information about the ocean?
    - What are challenges of exploring the ocean?
    - Why is it important to explore the ocean?
- Lead a discussion of why ocean exploration is important and encourage students to share their ideas about the kinds of people they believe might be involved with modern ocean exploration.
- Ask students if they have heard of the National Geographic Society. Encourage them to share what they know and briefly explain what the organization is if they are not familiar with it. Ask students to imagine that they are journalists working on an article for National Geographic Society's website: https://www.nationalgeographic.org. Their new assignment is to learn about the work of a modern ocean explorer and the methods they use to do their work.

Explore

- Pass out the "Ocean Explorers: Unlocking Mysteries" handout, one per student, or distribute it electronically. Ask them to think about which explorers they would like to learn more about and put a check mark next to those explorers. Then ask them

to rank their choices from 1–5 with numbers to the left of the check boxes. Or they may select another explorer they'd like to research.

- Ask students to tell you their first choice of explorers, or a second or third choice if classmates have selected those. Explain that they will be able to share their discoveries in a project format of their choice, such as a short presentation, video, animation or poster.
- Tell students that answering the questions on page two of the handout will prepare them for their project.
- Tell them there are two goals for the activity:
    - To be able to research the people and areas of discovery they find the most interesting.
    - To learn how scientists do their work. What processes (steps) do they follow? How do they record and document their discoveries and share information about their research?
- Briefly review strategies for conducting research.
    - Discuss with students how to evaluate the reliability of sources, with tips such as those presented at the "Teaching Adolescents How to Evaluate the Quality of Online Information" page from Edutopia: https://www.edutopia.org/blog/evaluating-quality-of-online-info-julie-coiro.
    - Suggest ideas for notetaking strategies, an area in which many students struggle. Good strategies include:
        - Creating notecards, with one card for each idea; sources should be given numbers, with the number and page or paragraph written on each card so students can remember where they found information
        - Using software that allows notes to be easily moved around, such as concept mapping software and presentation tools with a slide sorter, such as PowerPoint or Google Slides.
        - Demonstrate for students how each of these strategies allows them to easily organize their ideas by similar topics before or after trying to create an outline. Then they can finish planning a well-organized project, such as a presentation or research paper.
- Provide students with options for how they might create the visual components of their projects. They could use PowerPoint or another program to present their key points and engaging visuals, or they might use video/animation editing software, create a large poster or use another method that you approve.
    - Tell students that their goal is to help other students learn about the explorer and processes they use in their work. Stress the importance of this

being a persuasive presentation in which they seek to convince the audience why the person and their contributions are important.

    - Ask them to try to include only the key concepts in the visuals that will be presented, so those key details can be clarified and reinforced without distracting the audience with too much reading while the students are sharing their projects.

- Pass out copies of the "Ocean Explorers Project" rubric found at the end of the lesson so they know how they will be assessed. Tell them they will fill out the "Your Score" column and hand it in to you when they are ready to share their project with the class.
- Encourage students to look up information using the national marine sanctuaries https://sanctuaries.noaa.gov and NOAA Ocean Exploration https://oceanexplorer.noaa.gov websites. Consider arranging a visit to the school library or seeking assistance from a librarian and/or technology specialist to assist the class with finding information.
- Provide students with a deadline for when all the projects will need to be completed.
- Students conduct research and prepare their projects. Circulate through the class to answer any questions. Tell students they can complete projects outside of class time, if necessary.

Explain

- Ask students to present to the class about their explorers and/or do a gallery walk through posters and other projects. Ask the class to record interesting points from the projects in science notebooks.
- In a full class discussion ask these questions, which you could write on the board or project:
    - What procedures do scientists use to study the ocean?
    - What are the basic steps or processes of doing research?
    - How might the processes ocean explorers use differ from processes used in laboratory research?
    - How is new information about our ocean shared with others?
- Ask students to reflect on some of the many ocean mysteries yet to be investigated. What questions might they investigate as ocean explorers? Ask them to discuss the topic with a partner or small group, recording their ideas in science notebooks.

Enrich/Extend

- Ask students to explore one of the following sites to learn more about ocean-related careers:

- National Geographic Society's Ocean Explorers: https://www.nationalgeographic.com/impact/ocean
- Ocean Careers: Deep Ocean Exploration Project: https://deepoceaneducation.org/topic/ocean-careers
- NOAA's Ocean Exploration Career Profiles: https://oceanexplorer.noaa.gov/edu/oceanage

- Ask students to think about what the "Explorer Mindset" is and how it might help them and contribute to a better world. Give them a couple minutes to discuss their ideas with a partner or small group. Then they can share them with the class. Discuss their ideas and fill in details from the National Geographic Society: "While our Explorers represent diverse backgrounds and fields of work, they are united by shared values and commitments. National Geographic Explorers …
  - are leaders and problem solvers
  - are informed, curious, and capable individuals who are committed to making the world a better place
  - have a sense of responsibility and respect for other people, cultures, and the natural world
  - are empowered to make a difference, pursue bold ideas, and persist in the face of challenges
  - observe, document, and engage with the world around them
  - tell stories that inspire others
  - create and foster a global community committed to a sustainable future
  - are committed to supporting diversity, equity and inclusion in their fields."
- 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.
- Encourage students to participate in the Marine Advanced Technology Education (MATE) Center ROV competition: https://materovcompetition.org. More info about MATE is at https://www.marinetech.org and the "Scout" class intro competition is at https://materovcompetition.org/scout. Robonation's Sea Perch competition is another exciting option: https://robonation.org.

Evaluate

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

- Ask students to summarize what they learned about exploration and the scientific process in science notebooks or on separate paper. Students also might choose to add illustrations with labels to their written accounts.

Education Standards	
Next Generation Science Standards	Will vary; examples students can meet for relevant explorers: Science and Engineering Practices: • Asking Questions and Defining Problems • Developing and Using Models • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information Crosscutting Concepts: • Cause and Effect • Patterns • Systems and System Models
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	6. The ocean and humans are inextricably interconnected. (c, d, g) 7. The ocean is largely unexplored. (a, b, f)

Additional Resources

"Our Explorers." National Geographic Society: https://www.nationalgeographic.org/society/our-explorers

"Ocean Exploration Education Materials." NOAA: https://oceanexplorer.noaa.gov/edu/welcome.html

"Bathymetric Maps" fact sheet. NOAA: https://oceanexplorer.noaa.gov/edu/materials/bathymetric-mapping-fact-sheet.pdf

"Multibeam Sonar" fact sheet. NOAA: https://oceanexplorer.noaa.gov/edu/materials/multibeam-sonar-fact-sheet.pdf

"Remotely Operated Vehicles (ROV)" lesson plan. NOAA: https://nmsmonitor.blob.core.windows.net/monitor-prod/media/archive/education/pdfs/rov_lesson.pdf

"Science in Action!" lesson plan. Shape of Life: https://www.shapeoflife.org/lesson-plan/sol/science-action

"Shipwreck Explorers" lesson. NOAA: https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/docs/20220125-shipwreck-explorers.pdf

"Which Robot When?" lesson plan. NOAA Ocean Exploration: https://oceanexplorer.noaa.gov/edu/materials/which-robot-when-activity.pdf

For More Information

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