Ocean Literacy Essential Principle 7

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Georgia Association of Marine Educators Conference:
Ocean Literacy Rebooted

November 13, 2021

The Lawrence Hall of Science
UNIVERSITY OF CALIFORNIA, BERKELEY

USC Wrigley Institute for Environmental Studies

National Marine Educators Association
making known the world of water

Sea Grant

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA
U.S. DEPARTMENT OF COMMERCE

Essential Principle 7

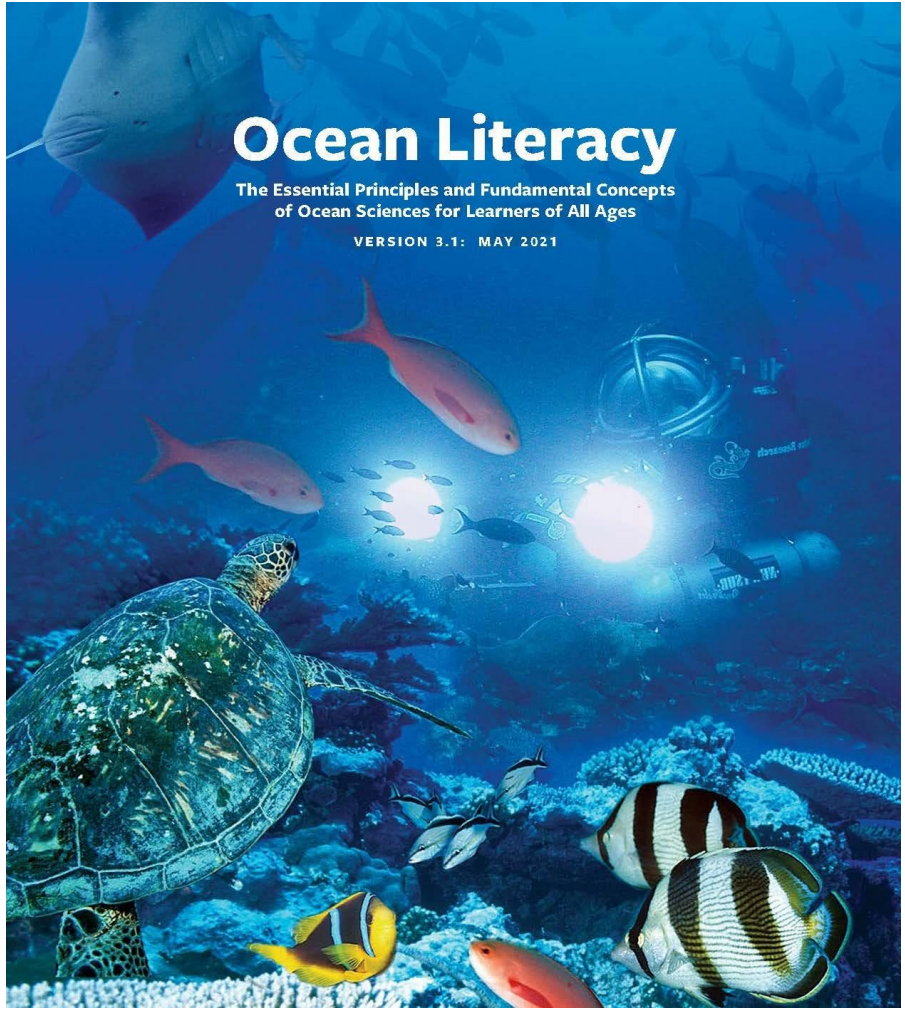
Using the OL Framework with Your Learners

1. **Look at the Guide** to determine the Essential Principles and Fundamental Concepts you want &/or need to address with your learners.
2. Then **look at the Scope and Sequence** for that principle for your grade level, and locate the concepts you decided to focus on.
3. Finally, **choose an activity** that addresses one or more of those concepts, following the flow shown in the scope and sequence.

Ocean Literacy Guide:

The Essential Principles & Fundamental Concepts of Ocean Sciences

http://www.marine-ed.org/ocean-literacy/guide



EP 7: The ocean is largely unexplored.

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b. Understanding the ocean is more than a matter of curiosity. **Exploration, experimentation, and discovery are required to better understand ocean systems** and processes.

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.

d. **New technologies, sensors and tools are expanding our ability to explore the ocean** system. Scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

e. Use of mathematical models is an essential part of the ocean systems. **Models help us understand the complexity of the ocean** and of its interaction with Earth's interior, atmosphere, climate and land masses.

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

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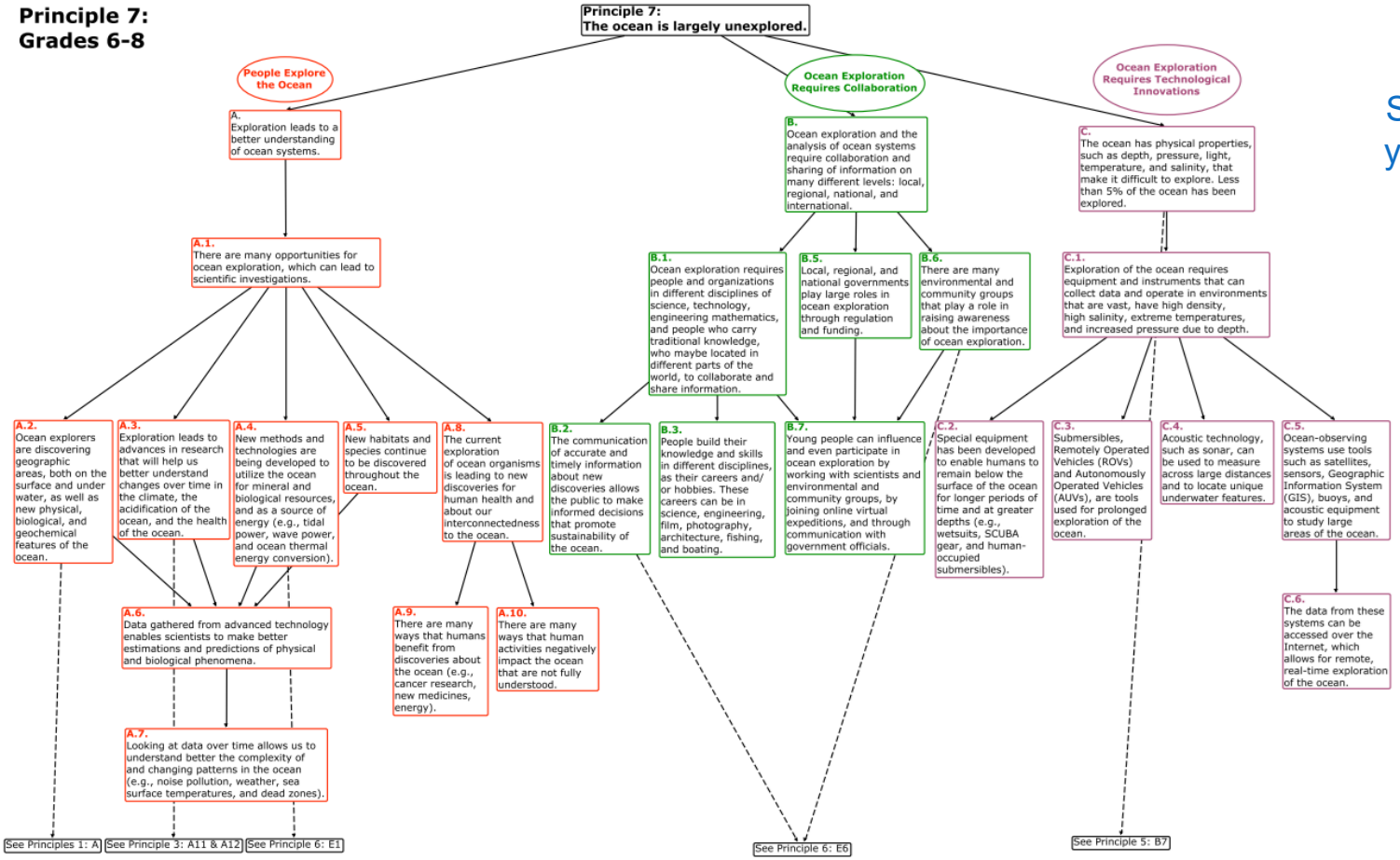
Principle 7: Grades 6-8



See p. 39 in your copy of the Handbook

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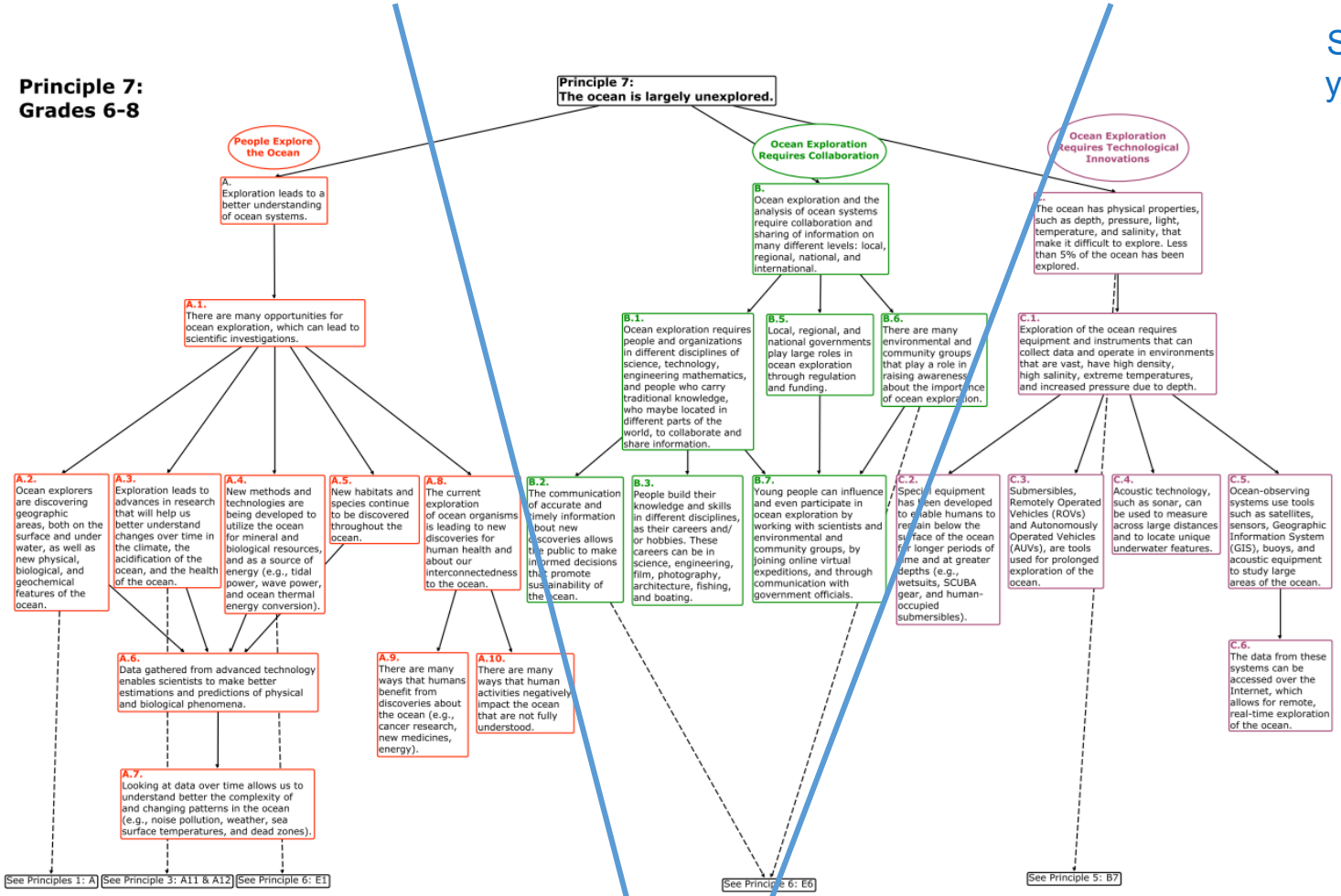

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People Explore the Ocean

A. Exploration leads to a better understanding of ocean systems.

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A.2. Ocean explorers are discovering geographic areas, both on the surface and under water, as well as new physical, biological, and geochemical features of the ocean.

A.3. Exploration leads to advances in research that will help us better understand changes over time in the climate, the acidification of the ocean, and the health of the ocean.

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A.5. New habitats and species continue to be discovered throughout the ocean.

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A.8. The current exploration of ocean organisms is leading to new discoveries for human health and about our interconnectedness to the ocean.

A.9. There are many ways that humans benefit from discoveries about the ocean (e.g., cancer research, new medicines, energy).

A.10. There are many ways that human activities negatively impact the ocean that are not fully understood.

See Principles 1: A | See Principle 3: A11 & A12 | See Principle 6: E1

Ocean Exploration Requires Collaboration

B. Ocean exploration and the analysis of ocean systems require collaboration and sharing of information on many different levels: local, regional, national, and international.

B.1. Ocean exploration requires people and organizations in different disciplines of science, technology, engineering mathematics, and people who carry traditional knowledge, who maybe located in different parts of the world, to collaborate and share information.

B.2. The communication of accurate and timely information about new discoveries allows the public to make informed decisions that promote sustainability of the ocean.

B.3. People build their knowledge and skills in different disciplines, as their careers and/or hobbies. These careers can be in science, engineering, film, photography, architecture, fishing, and boating.

B.5. Local, regional, and national governments play large roles in ocean exploration through regulations and funding.

B.6. There are many environmental and community groups that play a role in raising awareness about the importance of ocean exploration.

B.7. Young people can influence and even participate in ocean exploration by working with scientists and environmental and community groups, by joining online virtual expeditions, and through communication with government officials.

See Principle 6: E6

Ocean Exploration Requires Technological Innovations

C. The ocean has physical properties, such as depth, pressure, light, temperature, and salinity, that make it difficult to explore. Less than 5% of the ocean has been explored.

C.1. Exploration of the ocean requires equipment and instruments that can collect data and operate in environments that are vast, have high density, high salinity, extreme temperatures, and increased pressure due to depth.

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C.3. Submersibles, Remotely Operated Vehicles (ROVs) and Autonomously Operated Vehicles (AUVs), are tools used for prolonged exploration of the ocean.

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C.5. Ocean-observing systems use tools such as satellites, sensors, Geographic Information System (GIS), buoys, and acoustic equipment to study large areas of the ocean.

C.6. The data from these systems can be accessed over the Internet, which allows for remote, real-time exploration of the ocean.

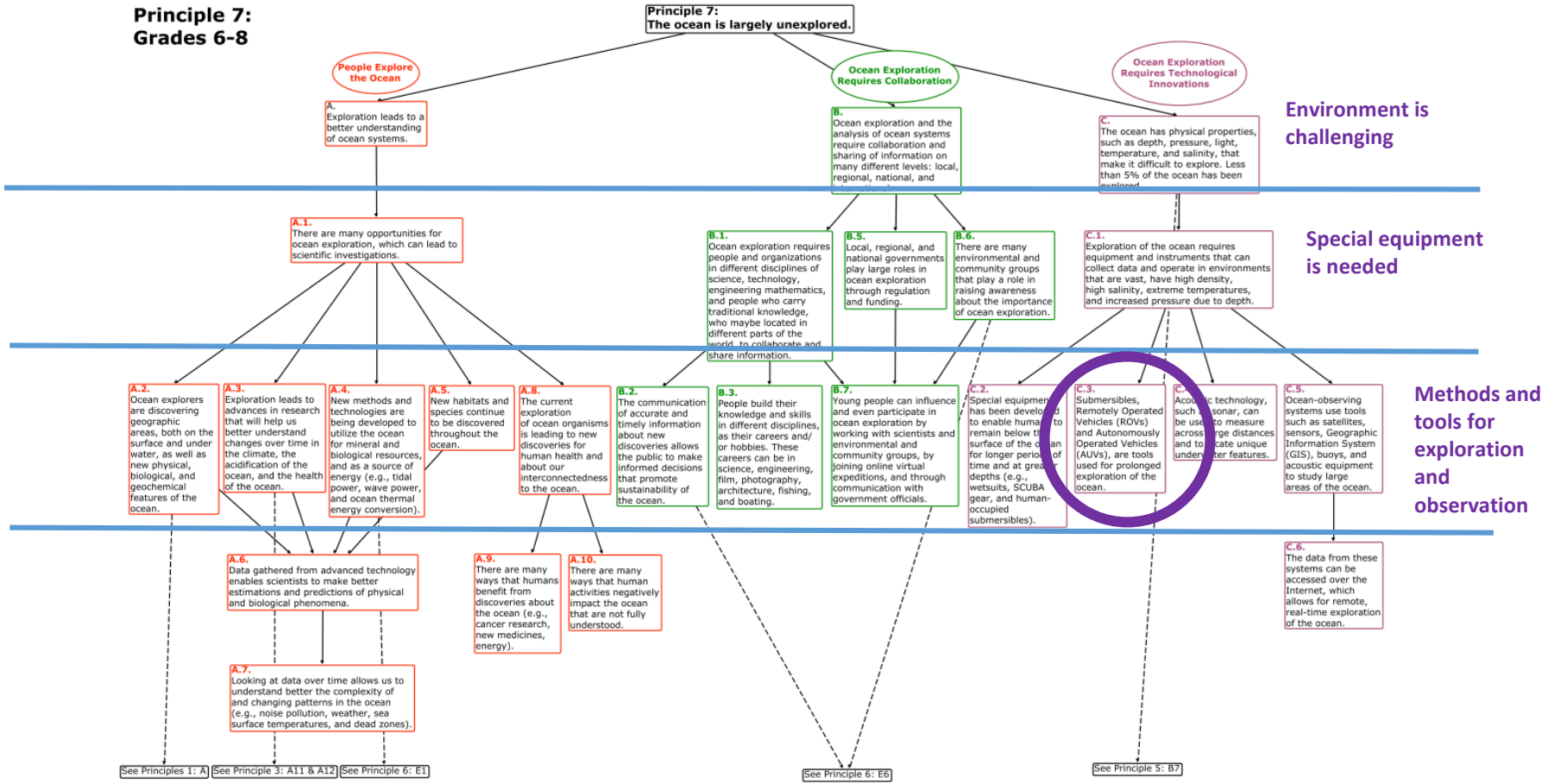
See Principle 5: B7

Environment is challenging

Special equipment is needed

Methods and tools for exploration and observation

Principle 7: Grades 6-8



Underwater Robots

STUDENT ACTIVITY: Which Robot When

Grade Level:

6th - 8th grade (Engineering/Technology)

Activity Description:

Students learn about the variety of underwater robots that are used for ocean exploration and the technical capabilities that differentiate them from one another. Students analyze several mission scenarios and apply their knowledge of underwater robots to figure out which robot is best suited for the task.

Activity Components:

- Which Robot When Activity (pdf)
- Exploration Vehicle Summary Sheets (pdf)

Standards:

Next Generation Science Standards (NGSS):
- **Performance Expectation:** MS-ETS1-1, MS-ETS1-2
- **Disciplinary Core Ideas:** ETS1.A, ETS1.B

Ocean Literacy Essential Principles:
- Principle 7

Supplemental Materials:

Fact Sheets
- Remotely Operated Vehicles (pdf)
- Autonomous Underwater Vehicles (pdf)

Exploration Notes - stories from the field
- Pilots "Fly" Using ROVs (pdf)
- The Challenges of ROV Operations at Sea Exploration (pdf)
- Sampling the Deep Sea (pdf)

OCEAN EXPLORATION

Which Robot When?

Overview

TOPIC: Underwater Robots

FOCUS: The varied technical capabilities of underwater robots (Physical Science/Engineering)

GRADE LEVEL: 6th-8th; extension and differentiation provided to adapt to other grade levels

TIME NEEDED: One or two 45-minute class periods

DRIVING QUESTIONS:
How can underwater robots help ocean explorers gather data under a variety of ocean conditions?
How do ocean explorers determine which piece of technology is best suited for their mission?

OBJECTIVES/ LEARNING OUTCOMES:
Students will:
- Become familiar with a variety of Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) that are used by ocean explorers.
- Analyze a variety of mission scenarios that underwater robot exploration devices might encounter.
- Distinguish shape and structural features among at least three types of underwater vehicles that make each suitable for specific ocean exploration tasks.
- Discuss, analyze and decide which vehicle is best suited for which situation.
- Participate in group decision-making to reach consensus.

MATERIALS:
- Board, flip chart, or preferred online platform for tracking Which Robot When for each mission scenario
- Student handouts

Essential Principle 7

Activity

Which Robot When

Home / Education / Education Themes / Underwater Robots / Lessons / Which Robot When

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Underwater Robots

STUDENT ACTIVITY: Simple Machines: Robot Building Blocks

Grade Level:

6th - 8th grade (Physical Science/Engineering)

Activity Description:

Students practice the engineering design process to develop a working manipulator arm for a Remotely Operated Vehicle (ROV). Through the design process, students explore how simple machines are combined and used to develop complex systems, like manipulator arms. Students also develop a hydraulic actuator, to convert energy into motion for their designs.

Activity Components:

- Simple Machines: Robot Building Blocks Activity (pdf)
- Simple Machines Student Handout (pdf)
- Engineering Design Process Student Handout (pdf)

Standards:

Next Generation Science Standards (NGSS):
- **Performance Expectation:** MS-ETS1-1, MS-ETS1-2
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Ocean Literacy Essential Principles:
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Supporting Images/Videos:

Hydraulic Actuator. *Image courtesy of NOAA Ocean Exploration.*
Download larger version. (206 KB)

Simple Machines: Materials Needed. *Image courtesy of NOAA Ocean Exploration.*
Download larger version. (5.2 MB)

Simple Robot Arm. *Image courtesy of NOAA Ocean Exploration.*
Download larger version. (4.1 MB)

https://oceanexplorer.noaa.gov/edu/themes/underwater-robots/lessons/simple-machines.html

Deep Ocean Education Project

Featuring high quality ocean exploration education materials from:

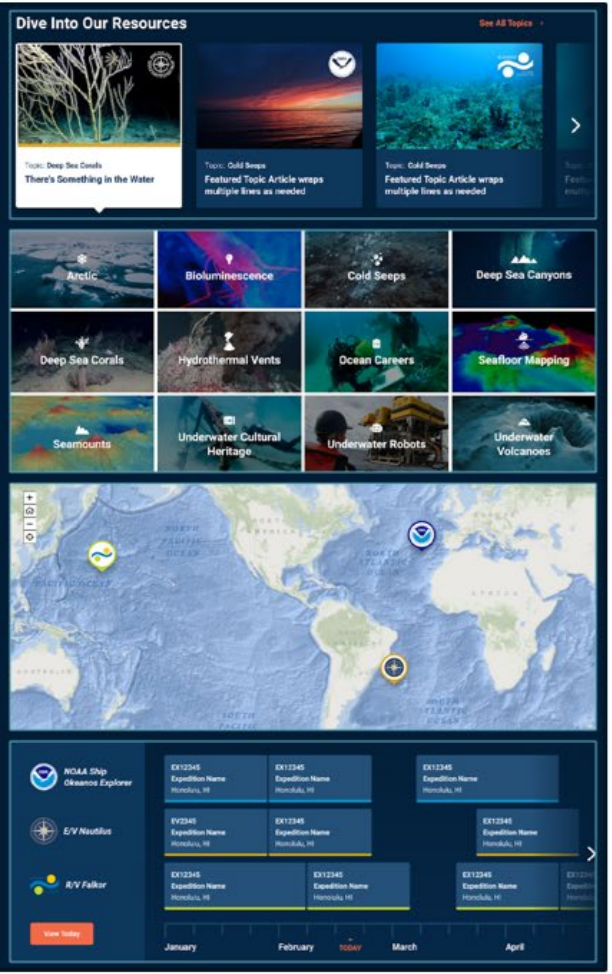
Ocean Exploration and Research

SCHMIDT OCEAN INSTITUTE

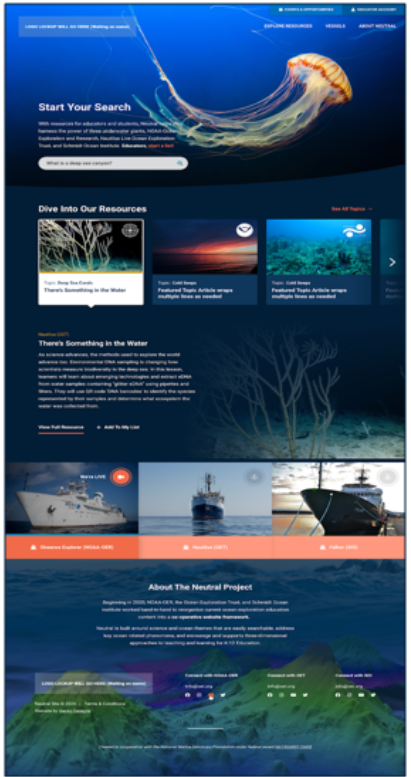
NAUTILUSLIVE.ORG OCEAN EXPLORATION TRUST

Created in cooperation with the National Marine Sanctuary Foundation under federal award NA190AR0110405

National Marine Sanctuary Foundation



What is the Deep Ocean Education Project?



- A collaboration among NOAA's Office of Ocean Exploration and Research (OER), Ocean Exploration Trust (OET), and the Schmidt Ocean Institute (SOI) bringing together high quality ocean exploration education materials from across the three organizations.
- The Deep Ocean Education Project website will serve as one-stop resource hub for educators and students looking for deep sea educational materials.
- The website will also feature information on how to connect with all three research vessels, including a list of upcoming events and opportunities, ship-to-shore connections, and live feeds of expeditions.

Ocean Exploration and Research
NAUTILUSLIVE.ORG OCEAN EXPLORATION TRUST
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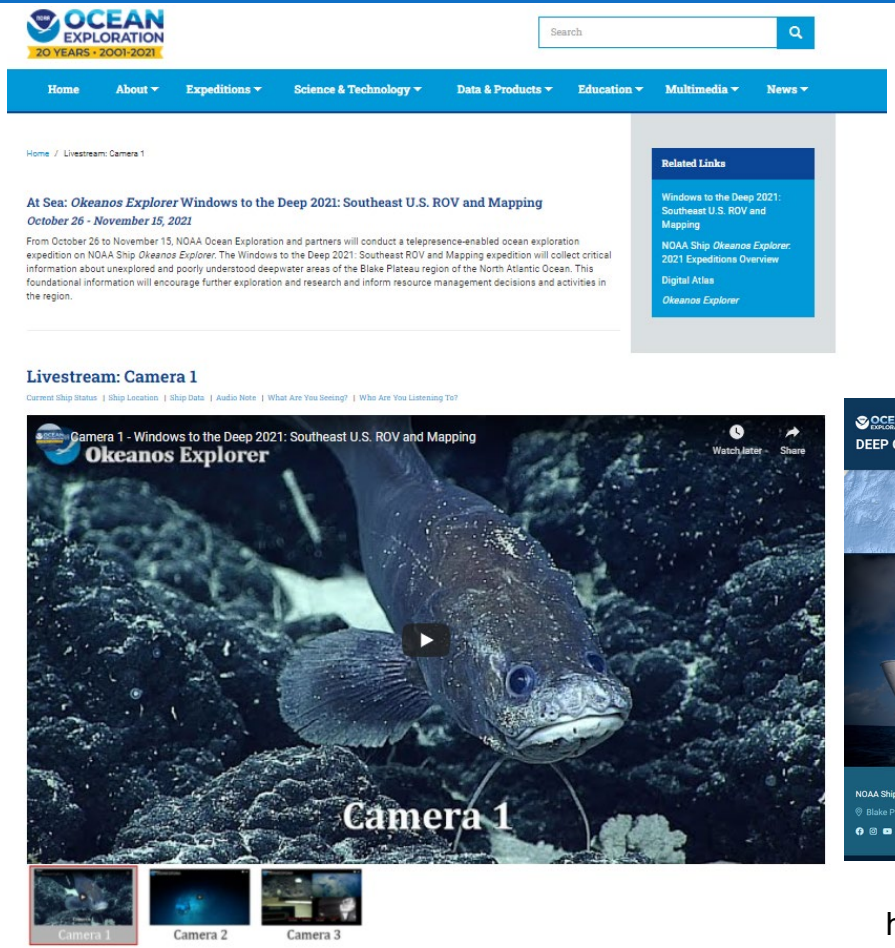
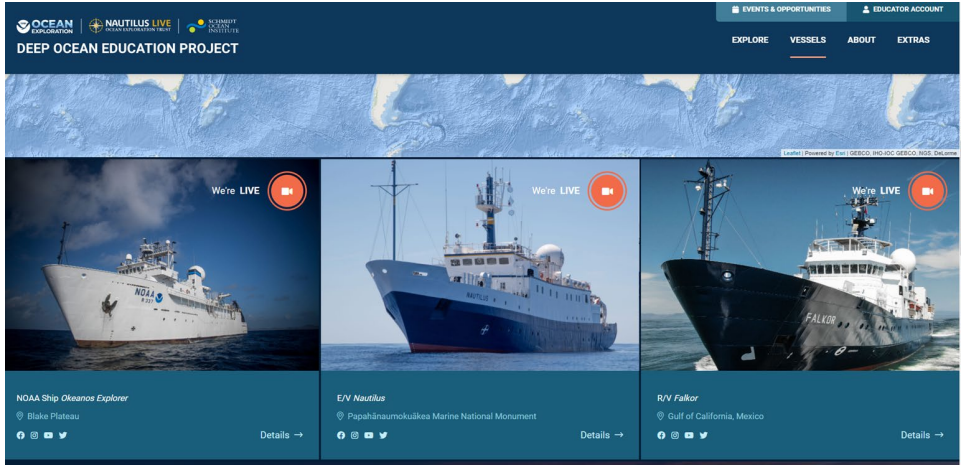


https://oceanexplorer.noaa.gov/livestreams/welcome.html



https://deepoceaneducation.org/vessels/

Pause & Reflect

in the South Pacific

Consider the following.

Scribble down your thoughts.

- Take a look at the Principle 7 scope and sequence for your grade level. What jumps out for you?
- Now, what would you like to tell someone about the scope & sequence?

Back-up Slides

Principle 1:
Grades 3-5

Strand Topic

Properties of Ocean Water

A.
97% of all water on Earth is salt water in the ocean.

Major concept of this strand

A.1.
Only 3% of all water on Earth is fresh water stored in lakes, rivers, underground aquifers, glaciers, and other places.

A.4.
Salinity and temperature vary throughout the ocean.

2 ideas that support bigger ideas in this strand

A.2.
Most of all the fresh water in the world is stored in ice caps and glaciers.

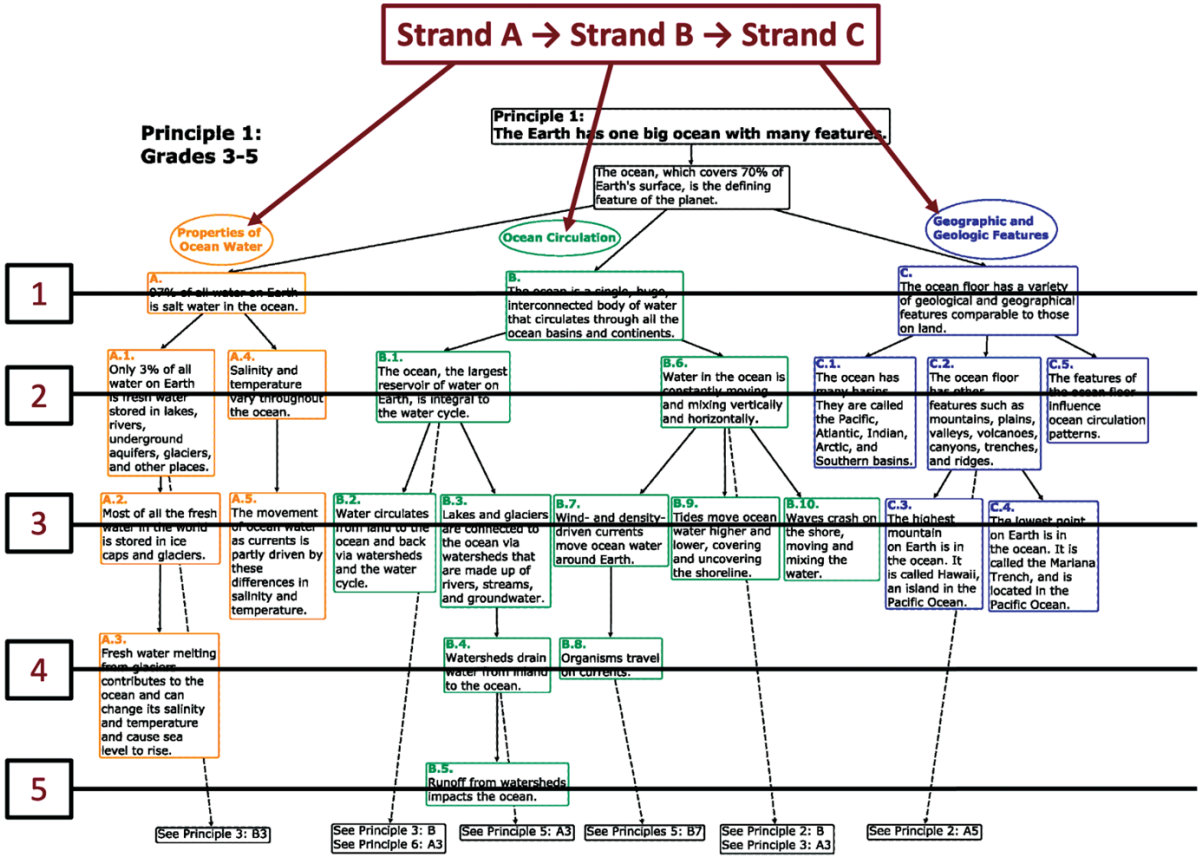
A.5.
The movement of ocean water as currents is partly driven by these differences in salinity and temperature.

Supporting ideas on properties of ocean water discussed in further detail

A.3.
Fresh water melting from glaciers contributes to the ocean and can change its salinity and temperature and cause sea level to rise.

See Principle 3: B3

For Grades 3-5, concept A2 in Principle 1 is connected to concept B3 in Principle 3



Dashed lines lead to cross-referenced concept statements in other essential principles.

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