OCEAN CLASSROOM LIVE!

Surfing the Southern Ocean (Episode 2)

EDUCATOR SUPPORT MATERIALS

THE UNIVERSITY OF RHODE ISLAND GRADUATE SCHOOL OF OCEANOGRAPHY

What can a robotic surfboard tell us about the rapidly warming Antarctic? In this episode of GSO Ocean Classroom (Live!), join GSO's Holly Morin and Ryan Newell of the University of Washington as they discuss the connections between the ocean, atmosphere and sea ice in the Southern Ocean. Using a Wave Glider—a wave-propelled autonomous surface vehicle—Newell and others at the University of Washington are measuring how heat and other properties move between the water and the air in some of the stormiest seas on the planet.

Discussion Questions

- Why is it important to study the physical properties of the Southern Ocean?
- Why use an autonomous surface vehicle, like the Wave Glider, to study physical properties of the Southern Ocean?
- What are differences between Arctic and Antarctic environments?

Resources

Graduate School of Oceanography
As one of the nation's premier academic oceanographic institutions, the University of Rhode Island's Graduate School of Oceanography (GSO) educates marine scientists, students, policymakers, business leaders and citizens and helps develop the knowledge and skills necessary to address present and future marine challenges.

- GSO: https://web.uri.edu/gso/
- Inner Space Center: http://innerspacecenter.org/
- Rhode Island Teachers At Sea: https://web.uri.edu/gso/research/outreach/rhode-island-teachers-at-sea-program/
- Narragansett Bay Classroom: https://web.uri.edu/gso/research/outreach/narragansett-bay-classroom/
- GSO Facebook: https://www.facebook.com/URIGSO/

University of Washington Applied Physics Laboratory
The Applied Physics Laboratory (APL) is a research unit of the University of Washington. The APL serves as a trusted research and development agent by anticipating broad scientific and engineering challenges and responding quickly to rising national research priorities. Core expertise is in ocean physics and engineering, ocean and medical acoustics, polar science, environmental remote sensing, and signal processing.

- Wave Glider Observations: http://www.apl.washington.edu/project/project.php?id=sowg
- UW team sending autonomous surfboard to explore Antarctic waters: https://www.washington.edu/news/2019/10/23/uw-team-sending-autonomous-surfboard-to-explore-antarctic-waters/

Antarctic Environments
- Antarctic food web: https://web.uri.edu/gso/publications/aboard-gso/issues/summer-2019/understanding-change-in-the-antarctic/
- Air/sea interaction in North Atlantic: https://web.uri.edu/gso/news/wind-powered-ocean-drone-launched-from-newport/
- Antarctic Animals trading cards: https://www.nsf.gov/news/classroom/images/arctic/OPP_AntarcticAnimals_DIY_2020_GD_v1.3jd_508_Final.pdf?fbclid=IwAR2Suy1vSG5DNHRixSZXAM4xgrXTwNI7XXJ4fhhBkMOCjjmOtBrVqPS_5kg

Suggested Standards

Next Generation Science Standards K-12 Performance Expectations relating to Polar/Antarctic environments and technologies.

Elementary School

Grade K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment
- K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.
- K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
- K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
- K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Grade K: Weather and Climate
- K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.
- K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
- K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.
- K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

Grade 1: Structure, Function, and Information Processing

- 1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

Grade 1: Space Systems: Patterns and Cycles
- 1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.

Grade 2: Structure and Properties of Matter
- 2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Grade 2: Interdependent Relationships in Ecosystems
- 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.

Grade 2: Earth's Systems: Processes that Shape the Earth
- 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
- 2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

K-2.Engineering Design
- K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Grade 3: Interdependent Relationships in Ecosystems
- 3-LS2-1. Construct an argument that some animals form groups that help members survive.
- 3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
- 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Grade 3: Weather and Climate
- 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a
- particular season.
- 3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

Grade 4: Structure, Function, and Information Processing
- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Grade 4: Earth's Systems: Processes that Shape the Earth
- 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Grade 5: Earth's Systems
- 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- 5-ESS2-2. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Middle School

MS. Energy
- MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS. Growth, Development, and Reproduction of Organisms
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS. History of Earth
- MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

MS. Earth's Systems
- MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

MS. Weather and Climate
- MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

MS. Human Impacts
- MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ESS3-3.Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

High School

HS. Natural Selection and Evolution
- HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS. Earth's Systems
- HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS. Weather and Climate
- HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS. Human Sustainability
- HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

[Ocean Literacy Principles](#)
OLP1: The Earth has one big ocean with many features.
OLP2: The ocean and life in the ocean shape the features of Earth.
OLP3: The ocean is a major influence on weather and climate.
OLP4: The ocean makes Earth habitable.
OLP5: The ocean supports a great diversity of life and ecosystems.
OLP6: The ocean and humans are inextricably interconnected.
OLP7: The ocean is largely unexplored