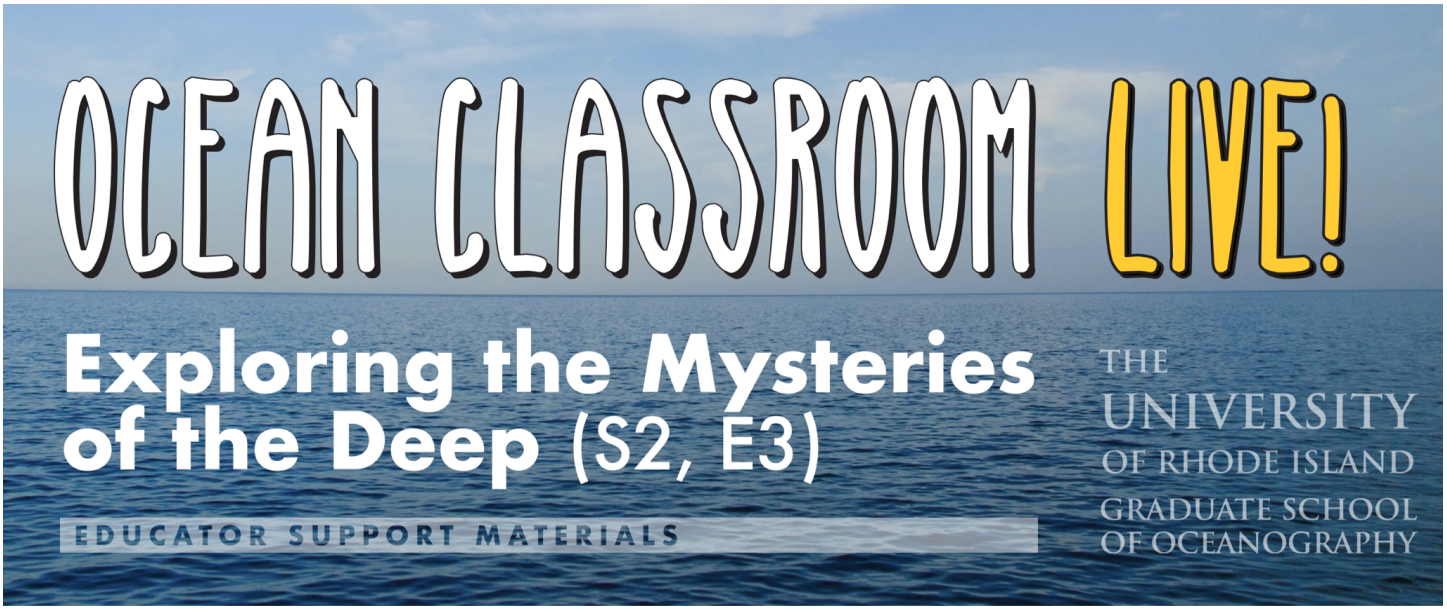

Our future depends on understanding the ocean, yet the majority of this vast, underwater realm remains unmapped, unobserved and unexplored. Scientists and engineers are teaming up to tackle this challenge and develop the technology needed to explore the ocean. What discoveries are yet to be made? Join GSO professor and director of the Ocean Exploration Cooperative Institute (OECI) Adam Soule and Jason Fahy, OECI Assistant Director as they discuss the latest innovations used to investigate the ocean depths, what science and society stand to gain from ocean exploration, and where ocean explorers are headed next.

Discussion Questions

- What technologies are used for ocean exploration?
- Why is it important to explore the ocean?
- What connections can be made between space and deep sea exploration?

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/
- GSO Ocean Classroom: https://web.uri.edu/gso/outreach/ocean-classroom/
- GSO Facebook: https://www.facebook.com/URIGSO/
- GSO YouTube: https://www.youtube.com/c/URIGraduateSchoolofOceanography
- GSO Twitter: https://twitter.com/urigso

Other Resources

- Nautilus Live: https://nautiluslive.org
- NOAA Ocean Exploration and Research: https://oceanexplorer.noaa.gov
- NOAA announces $94-million ocean exploration institute led by URI: https://web.uri.edu/gso/news/noaa-announces-94-million-ocean-exploration-institute-led-by-uri/
- Science Friday with Adam Soule (The Firey Mountains Under the Sea): https://www.sciencefriday.com/segments/the-fiery-mountains-under-the-sea/
- Sea Perch ROV: https://seaperch.org/
- A Quick Dive Into How Submarines Work: https://www.npr.org/2021/03/16/977960050/a-quick-dive-into-how-submarines-work?fbclid=IwAR0CDM9zoEvqMMgcJxnYibpJWWPwEttvQVaxthpMqMdmx7UNqyiOIw4PE30

Suggested Standards

Next Generation Science Standards K-12 Performance Expectations relating to Ocean Exploration.

Elementary School

K: Motion and Stability: Forces and Interactions

- K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

Grade 2: Earth's Place in the Universe

- 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

K-2-ETS1 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: Motion and Stability: Forces and Interactions

- 3-PS2-1.Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Grade 4: Earth's Systems

- 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features

Grade 5: Motion and Stability: Forces and Interactions

- 5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down

Grade 3-5: Engineering Design

- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Middle School

MS: Motion and Stability: Forces and Interactions

- MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object

MS: Engineering Design

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

High School

HS: Motion and Stability: Forces and Interactions

- HS-PS2-1.Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS: Engineering Design

- HS-ETS1-1.Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Ocean Literacy Principles

OLP1: The Earth has one big ocean with many features.

OLP6: The ocean and humans are inextricably interconnected.

OLP7: The ocean is largely unexplored.