

OCEAN CLASSROOM LIVE!

The Totally True Story of the Sharkcano (Ep. 8)

EDUCATOR SUPPORT MATERIALS

THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY

“Sharkcano” might conjure images of a terrible made-for-TV movie, but join Brennan Phillips (URI Department of Ocean Engineering), about his explosive discovery: sharks swimming in sizzling hot water within an underwater volcano! Watch this great example of the incredible—and often unexpected—discoveries that ocean scientists make.

Discussion Questions

- What technologies are used to study extreme ocean environments?
- How do animals adapt to live in extreme underwater environments?
- Where are underwater volcanoes located and how are they formed?

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/>
- Learn more about Brennan Phillips: <https://web.uri.edu/gso/meet/brennan-t-phillips-phd/>
- 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/>
- GSO YouTube: <https://www.youtube.com/channel/UC8PuK-Y-E4zB9or3wcPg8CA>

Other Resources

- Sharkcano paper (open access):
<https://tos.org/oceanography/article/exploring-the-sharkcano-biogeochemical-observations-of-the-kavachi-submarin>
- Skate eggs paper (open access): <https://www.nature.com/articles/s41598-018-20046-4>
- Blowing up a robot in Kavachi (Nat Geo Expedition Raw):
<https://video.nationalgeographic.com/video/expedition-raw/0000015b-7c61-dce2-ad5f-7cebb0cd0000>

Suggested Standards

[Next Generation Science Standards](#) K-12 Performance Expectations relating to collecting data, ecosystems/animals.

Elementary School

Grade K: From Molecules to Organisms: Structures and Processes

- K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.

Grade K: Earth and Human Activity

- 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 1: From Molecules to Organisms: Structures and Process

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

Grade 1: Heredity: Inheritance and Variation of Traits

- 1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.

Grade 2: Biological Evolution: Unity and Diversity

- 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
- 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

Grade 3: From Molecules to Organisms: Structures and Processes

- 3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

Grade 3: Ecosystems: Interactions, Energy and Dynamics

- 3-LS2-1. Construct an argument that some animals form groups that help members survive.

Grade 3: Heredity: Inheritance and Variation of Traits

- 3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
- 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

Grade 3: Biological Evolution: Unity and Diversity

- 3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
- 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.

Grade 4: From Molecules to Organisms: Structures and Processes

- 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 5: Energy

- 5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Grade 5: Earth and Human Activity

- 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: From Molecules to Organisms: Structures and Processes

- MS-LS1-4. Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

MS: Ecosystems: Interactions, Energy, and Dynamics

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS: Biological Evolution: Unity and Diversity

- MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
- MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

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: Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS: Heredity: Inheritance and Variation of Traits

- HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and /or(3) mutations caused by environmental factors.
- HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS: Biological Evolution: Unity and Diversity

- HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- 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-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS: Earth's Systems

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

[Ocean Literacy Principles](#)

OLP2: The ocean and life in the ocean shape the features of Earth.

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