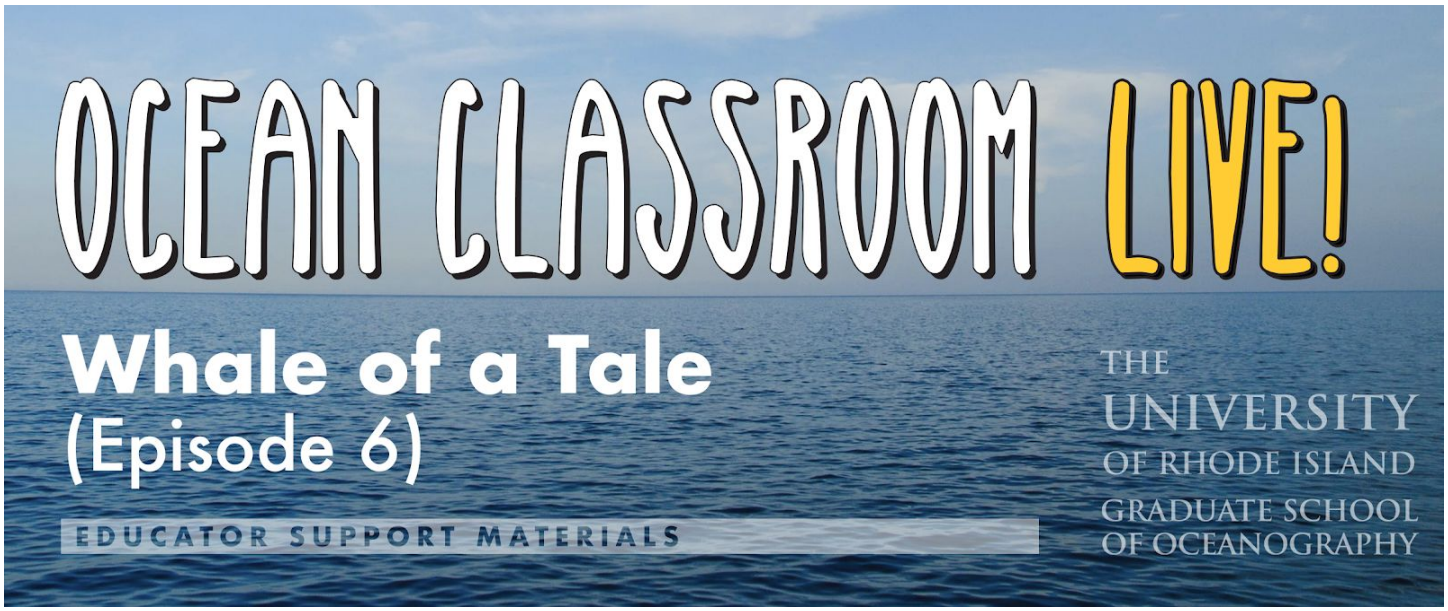

Whales are abundant in the coastal waters of New England, but what is it about the region that makes these ocean giants return year after year? In this episode of Ocean Classroom (Live!), URI Graduate School of Oceanography alum and NOAA research zoologist Chris Orphanides joins host Holly Morin of the Inner Space Center to discuss food web dynamics in the waters of southeastern New England, why they are so important to species such as the endangered North Atlantic right whale, and how these food webs might be changing. You'll also hear about the latest technologies that scientists use to better understand whales and other animals found in New England waters.

Discussion Questions

- What types/species of whales can be found in New England?
- What is causing local changes to whale distributions along the Atlantic coast?
- What is a food web and how do whales fit into that system?
- How do you study whales? Why is it important to study whales?

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/
- GSO Profile of Chris Orphanides: https://web.uri.edu/gso/news/gso-profiles-christopher-orphanides/

- Endeavor Live!: https://web.uri.edu/gso/news/not-your-typical-undergraduate-class-endeavorlive/ https://web.uri.edu/gso/publications/aboard-gso/issues/summer-2019/an-endeavor-to-explore-and-educate/

NOAA

NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce. There are five regional offices, six science centers, and more than 20 laboratories around the United States and U.S. territories, and we work with partners across the nation.

- NOAA Fisheries: https://www.fisheries.noaa.gov
  - North Atlantic Right Whale: https://www.fisheries.noaa.gov/species/north-atlantic-right-whale
  - Listening for Right Whales in the Gulf of Maine: https://www.fisheries.noaa.gov/feature-story/listening-right-whales-gulf-maine
- Northeast Fisheries Science Center: https://www.fisheries.noaa.gov/about/northeast-fisheries-science-center
  - North Atlantic Right Whale Sighting Survey: https://nefsc.noaa.gov/psb/surveys/NARWSS.html
  - Interactive North Atlantic Right Whale Sightings Map: https://nefsc.noaa.gov/psb/surveys/
- Stellwagen Bank National Marine Sanctuary: https://stellwagen.noaa.gov/
  - Whale Research: https://stellwagen.noaa.gov/science/researchprograms.html

Other Resources

- Woods Hole Oceanographic Institution, Right Whales: https://www.whoi.edu/know-your-ocean/ocean-topics/ocean-life/marine-mammals/right-whales/
  - Mark Baumgartner's lab: https://www2.whoi.edu/site/baumgartner-lab/
  - Michael Moore's lab: https://www2.whoi.edu/staff/mmoore/
  - Marine Mammal Behavior Laboratory: https://www.whoi.edu/page.do?pid=39335
- Bigelow Laboratory for Ocean Sciences, Whales and Warming in the Gulf of Maine: https://www.bigelow.org/news/articles/2019-07-20.html
- Syracuse University (Dr. Susan Parks): Bioacoustics and Behavioral Ecology Lab: https://parkslab.syr.edu/research/

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: Space Systems: Patterns and Cycles

- 1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.

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.

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-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
- 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 3: Earth's Systems

- 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: 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: Ecosystems: Interactions, Energy, and Dynamics

- 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

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: 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: Heredity: Inheritance and Variation of Traits

- MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

MS: Biological Evolution: Unity and Diversity

- MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
- 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-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
- 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-LS4-5. Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.
- 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: Earth and Human Activity

- 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: Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- 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-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- 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. Biological Evolution: Unity and Diversity

- 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 feedbacks that cause changes to other Earth systems.

HS. Weather and 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: Earth and Human Activity

- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Ocean Literacy Principles

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