Regional Class Research Vessel

Oregon State University

Voices From the Deep

Timeframe

2-3 Fifty minute class periods

Target Audience

Grades 4th- 6th

Suggested Materials

- Whale PPT
- Whale sound clips
- Graph paper

Contact:

SMILE Program

smileprogram@oregonstate.edu

http://smile.oregonstate.edu/

Description

Students analyze popular and classical songs to understand how people use music to communicate. Students construct a graph to diagram real whale song sounds and create lyrics for whale song phrases. In addition, students will examine ways scientists capture whale songs and human sources of noise pollution in whale habitats.

Objectives

Students will:

- Describe the singing behavior of three whale species off the Oregon coast
- Describe how scientists record and analyze whale songs
- Label the x-axis, y-axis, and title of a graph
- Write song lyrics that reveal insight about the singing behavior of whales

Essential Questions

Why do different whale species sound different?

How do scientists study whale vocalization?

How do human activities create noise pollution that may affect the behavior of humpback whales?

Background Information

There is a great deal about whales and other cetaceans that we still do not know, and even more we only know very little about. That's why many researchers and research organizations all over the world are studying aspects of whale biology, ecology, and evolution. This research plays a crucial role in helping us to determine how best to protect and conserve whales and manage the threats affecting their short and long-term survival.

Whale communication is one of the many things that researchers focus on. The sounds of waves and storms at the surface, of earthquakes and underwater landslides, of schooling fish, and of whales fill the underwater world. Whales use these natural sounds

and sounds that they produce for just about every aspect of their lives. All whales produce sound. Just as no two species look or behave the same, no two species make the same set of sounds. Toothed whales, like dolphins and porpoises, make click-type sounds and most also produce whistles in the higher frequencies. Baleen whales, like blue and fin whales, make a wide variety of lower frequency tones and upswept or downswept calls.

Whale researchers use sound recorded through underwater microphones, or hydrophones, as a method of detecting, tracking, and identifying whales. One way to analyze these signals from the hydrophone is to digitize them using a computer and to display them as a spectrogram. A spectrogram is a way to visualize sound like a picture. The computer draws an image of a sound over time that puts higher frequencies above lower ones, like the sheet music that musicians read. It also shows the intensity of the sounds by color or contrast.

Humans also introduce sounds into the ocean. Exploration for undersea natural resources, naval sonar, geophysical research, marine industry, fishing activities, and ships of all types produce sounds. In some areas, these man-made sounds are so loud that they may have an effect on a whale's ability to communicate or to navigate. For example, there is worry that the Killer Whale population in Puget Sound may be struggling to communicate or hunt due to an increase in vessel traffic noise. While the effects of increasing noise pollution in the ocean are not well known, certain types of sound, like high-intensity military sonar, appears to cause injury to highly-sensitive species like the beaked whales. There have been numerous reports of marine mammal strandings happening after navy sonar blasts or drilling activity.

The Geospatial Ecology of Marine Megafauna Lab is a part of the Marine Mammal Institute at Oregon State University. They are currently utilizing marine mammal acoustics for multiple projects, including "Cetacean use of sensory systems in foraging ecology," "Ecology of blue whales in New Zealand," and "Evaluation of gray whale hormone and body condition variation, with response to variable ambient ocean noise conditions." OSU has also recently dropped two hydrophones to the seafloor off the Oregon Coast, aided by the research vessel the Pacific Storm.

Activity Introduction:

Have students share ideas about what they already know or have heard about whales. Provide students with background information about the different kinds of whales using the PPT provided. Let students know that this lesson will focus on baleen whales. Show the following video clip of a humpback whale singing: https://www.youtube.com/watch?v=WabT1L-nN-E

Next Generation Science Standards

PERFORMANCE EXPECTATIONS:

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems

DISCIPLINARY CORE IDEAS:

MS-LS1.B. Growth and Development of Organisms

LS2.A.: Interdependent Relationships in Ecosystems

SCIENCE AND ENGINEERING PRACTICES:

Analyzing and Interpreting Data

Obtaining Evaluating, and Communicating Information

CROSSCUTTING CONCEPTS:

Structure and Function

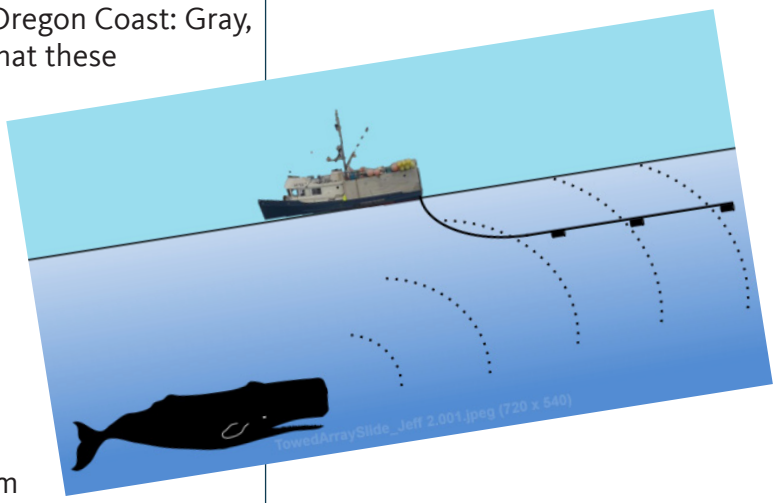
Ask students to discuss in pairs why they think whales volcalize? Share out some ideas. Let students know that they are going to do some activities to help them to answer this question.

Activity:

1. Play segments of various songs, and engage students in a discussion about how people communicate through music using different sounds.
   - Play short segments of 3–4 different popular songs (i.e. pop, reggae, hip hop), and ask the students to identify the type of music and to determine the message being communicated for each song. Messages may include love, friendship, nature, etc
   - Play short segments of 2–3 different classical songs, and ask the students to identify the type of music and to determine the message being communicated for each song. For example, play part of a happy song and part of a sad song. (Suggested website to download free classical music: www.classiccat.net/)

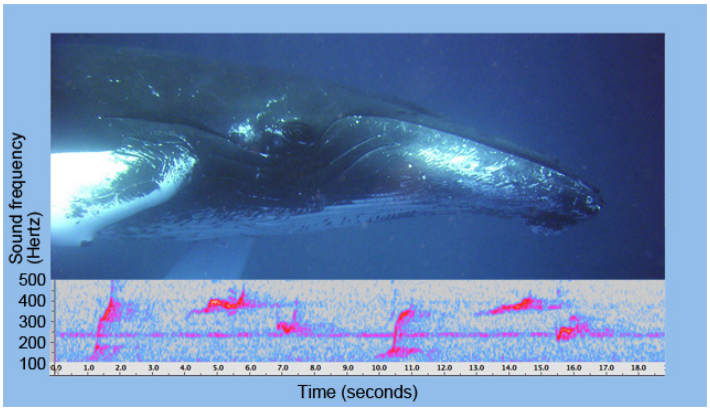
2. Ask the students to explain how they determined the message for each song. For example, the students might state that a song is about happiness or excitement because of the fast, upbeat tempo. If a slow, mournful song is played, the students might state that it is a song about sadness.

3. Tell students that they will have a chance to listen to whale sounds from three different species that live off of the Oregon Coast: Gray, Humpback, and Blue whales and hypothesize what these whales might be communicating. Ask students to think about how scientists are able to collect and study whale sounds. Share out ideas. Let students know that a hydrophone is an underwater microphone that will listen to or pick up acoustic signals. A hydrophone array can be towed behind a ship or placed on the seafloor.



4. Play each audio clip of the individual whales. After each whale that students listen to ask them if they can identify the type of sound, and what they think the sound sample is communicating. Ask the students to describe the sounds they hear. List student responses on the board. Possible responses may include loud, quiet, high, low, squeaks, chirps, growls, moans, and others. These are the kinds of sounds that scientists who study whale vocalization listen to and record to learn more.

5. Explain that now the class will have a chance to be like scientists who study whale volcalizations. They will listen to whale sounds again and track the sounds that they hear on a graph. Introduce a spectrogram to students. A spectrogram is a way to see sound. Show students an example. Higher frequency sounds are placed above lower frequency sounds on the graph while sound strength can be represented by brightness of the color. Time advances from left to right. Have students create and label their graphs and then listen to sounds. They may need to practice a few times first.

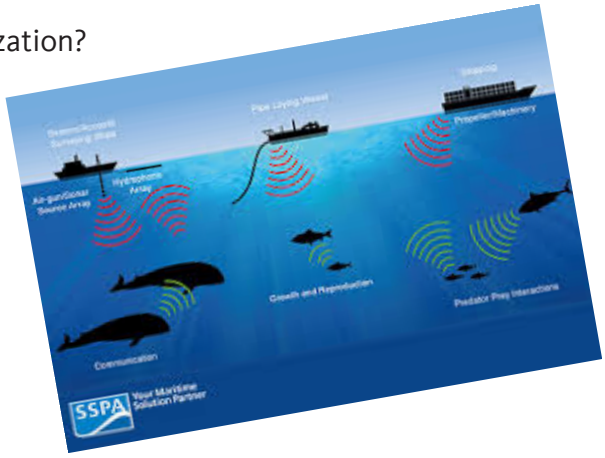


6. Have students listen to the whale song from the video at the start of the lesson again. Remind students that the male humpback whales are the only whales who actually sing. Have students come up with lyrics for the song that they heard. Include the following:
   - WHAT is this whale singing about?
   - WHERE is the singing taking place? (Describe the environment.)
   - WHO is the whale singing for?

7. Have the students share their whale song lyrics with the class. You might want to put the students into pairs or small groups to begin the sharing process to break the ice, then ask for volunteers to share (sing their song) with the whole class. Challenge the students to sing their whale songs with similar pitch and amplitude as the whale song phrases.

Wrap Up

- Why is it important for scientists to study whale vocalization?
- How would noise disturbances in the ocean affected whales? Would it change their behavior, thinking or work ability, or frighten them?



Explain to the students that scientists are currently studying how technology in the marine environment (military defense sonar, oil drilling, and ship engines) affects the behavior and survival of whales.

Extension

Have students make their own whale call using a balloon. Demonstrate how students can make calls using a balloon. Show how to stretch, blow up and then release air at different intervals to make the sounds. Have students practice and then make what they think would be a good whale call. If they work in pairs one student can make a spectrogram while the other plays their whale call.

Have students listen to whales at an underwater volcano in Hawaii: https://www.npr.org/templates/story/story.php?storyId=12205418

Why are they there and what are they communicating?

This project is supported by the Regional Class Research Vessel Program in the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University.

Resources:

Adapted from Harmonizing With Humpbacks: https://coast.noaa.gov/data/SEAMedia/Lessons/G4U4L3%20Harmonizing%20with%20Humpbacks.pdf

Voices in the Sea http://cetus.ucsd.edu/voicesinthesea_org/docs/education/PDFs/lesson4.pdf

Discovery of Sound in the Sea: https://dosits.org/people-and-sound/investigate-marine-animals/how-is-sound-used-to-study-marine-mammal-distribution/

Marine Mammal Institute: https://mmi.oregonstate.edu/gemm-lab/research-projects

European Science Foundation: www.marineboard.eu/file/62/download?token=DhvLbuVe