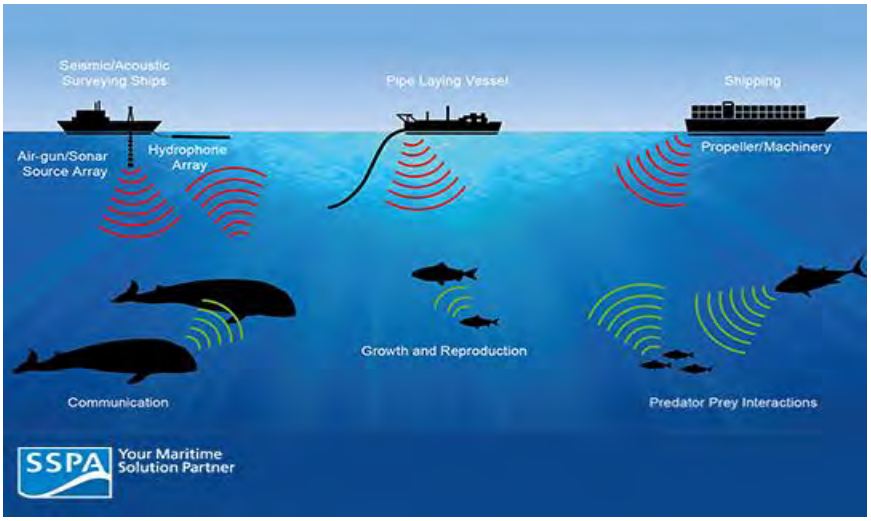
How Increased Ocean Noise Affects Whales

Photo: Credit *Ed Lyman/NOAA*



Grade Level

3-5

Timeframe

2.5 hours (could be broken into multiple lessons)

Materials

1. For activities:
   - 10 feet of rope - how waves work
   - Attached worksheet #1- paper-cut up into strips
   - Space (i.e.- open area free of furniture to allow students walking movement)
2. For background information:
   - Computer
   - Projector
   - Five videos to be downloaded (see Procedures)
3. For assessment:
   - Attached worksheet "Helping Whales"

Activity Summary

Hands-on activities and a selection of videos will show students how increasing ocean noise affects whales and their ability to communicate with each other. Students will learn how whales communicate, how sound travels in waves, and how sound travels faster in water than in air. Students will also learn how the deployment and recovery of acoustic mooring devices help scientists measure ocean noise. After students take a mini-assessment, the lesson invites students to think of solutions to help the whales.

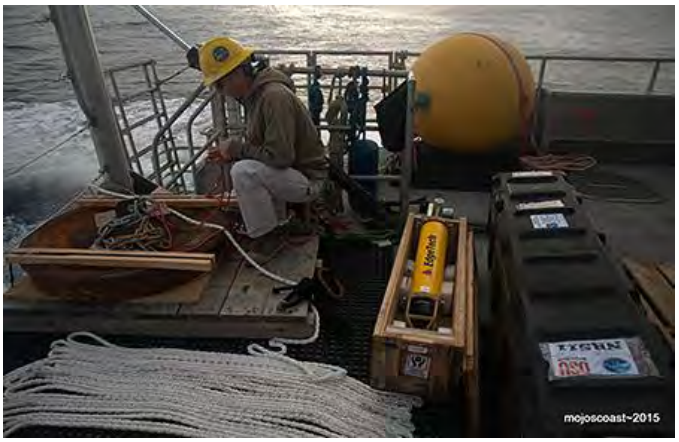
Learning Objectives

Students will be able to:

- Describe and show how sound travels in waves;
- Learn about the structures and functions of whales;
- Describe the sounds whales make;
- Explain how whales use sound to communicate (i.e. to locate prey; navigate, reproduce, etc.);
- Explain why there is increased noise in the oceans;
- Explain how noise pollution disturbs whales' communication;
- Explain how scientists analyze data from a hydrophone to measure ocean noise;
- Write and draw pictures of possible solutions to protect the whale population and decrease human-produced ocean noise.

Background Information

The oceans have become much noisier over the past 50 years, largely due to commercial shipping. As shipping traffic increases and ships get bigger and noisier, underwater noise pollution is becoming a larger issue around



Key Words

- **Five Senses (touch, taste, sight, smell hear)**
- **Communicate**
- **Sound wave**
- **Hydrophone**

the world. Sonar activities, including from military vessels and oil exploration are another source of noise.

Ocean noise impacts marine mammals such as whales in many ways. They use sound to feed, to communicate with each other for predator avoidance, and for reproductive activities. Many marine mammals respond to noise by altering their breathing rates, increasing or reducing their time underwater, changing the depths or speeds of their dives, shielding their young, changing their song durations, and swimming away from the affected area. Extreme noise pollution may cause temporary or permanent hearing loss. Disorientation and hearing loss may account, in part, for cases in which ships collide with whales that are apparently unaware of the approaching vessel.

National marine sanctuary scientists and partners strive to understand what types of noise and how much noise occurs in the ocean, both natural and from humans. In 2015, an acoustic monitoring device (a hydrophone) was deployed in Cordell Bank National Marine Sanctuary to record low frequency sound in the ocean such as from commercial ships and whales. Analysis of this data, as well as from hydrophones in marine sanctuaries around the country will help scientists learn about the ocean soundscape and impacts to whales.

In this lesson, students will first focus on the structures and functions of whales and learn how important it is for them to communicate through making sounds. In the first hands-on activity, they will learn how sound waves travel. In the second activity, they will simulate how whales communicate with one another, and how other noise in the environment can disturb their communication. Through watching videos, students will observe what is going on in our increasingly loud ocean today. They will hear how whales communicate, and learn of the human activities that are making our ocean louder, and of the adverse effects of noise pollution on whales. Through learning about the deployment and collection of a hydrophone off the Marin/Sonoma Coast in Cordell Bank National Marine Sanctuary, students will discover how scientists study ocean noise and work to protect whales. Students will end the lesson by taking a mini assessment, and then drawing and writing ideas to show how we can strike a balance between maintaining quiet oceans while understanding the needs of a complex and growing interconnected global economy.

Preparation

- Download all associated videos and text:
- Why do whales sing? - Stephanie Sardelis | TED-Ed
- Songs of Whales Drowned by Man Made Noise- SONIC SEA from Discovery Channel
- Ocean Noise Pollution -Discovery
- Noise at Cordell Bank National Marine Sanctuary | Office of National ...
- Humpback whales communicate through sound without vocal chords-

Vocabulary

Sound wave- A pattern of vibration caused by the movement of energy traveling through air, water, or other liquid or solid, as it moves away from the sound's source.

Animal Structure- The internal and external body parts, i.e. anatomy, of a living organism that allows it to function in its environment- i.e. flippers, tail, ears.

Animal Function- The actions, i.e. physiology, that a living organism make in order to survive i.e. reproduction, growth, eliminate waste.

Ecosystem- A system formed by the interaction of a community of organisms with their environment.

Hydrophone- A microphone that detects sounds waves under water

CBS Evening News

- Cut up "Sound Game"- Worksheet # 1
- Make appropriate numbers of copies of "Helping Whales" (there should be one per student). Note that it is two-sided.

Procedure

Engaging Students- Background Knowledge:
(15 minutes)
Ask Students: *How do animals use information to help them survive?*

1. Review five senses on dry erase or chalkboard.

2. Talk about two senses that your body uses in order to take in information: Touch and Taste.

3. Talk about three other ways to take in sensory information: Sight, Smell, Hearing

4. Explain that light and odors do not travel well in water, so ask students- "What sense do you think most marine mammals use to communicate"? Sound!

5. Show Ted EX video on Whale Songs:
(5:12 minutes) (It is closed captioned and available in several languages.)
Why do whales sing? - Stephanie Sardelis Ted EX

-Have students share the ideas they heard about why whales sing.
-Ask students: *What types of important activities do YOU use sound for?*

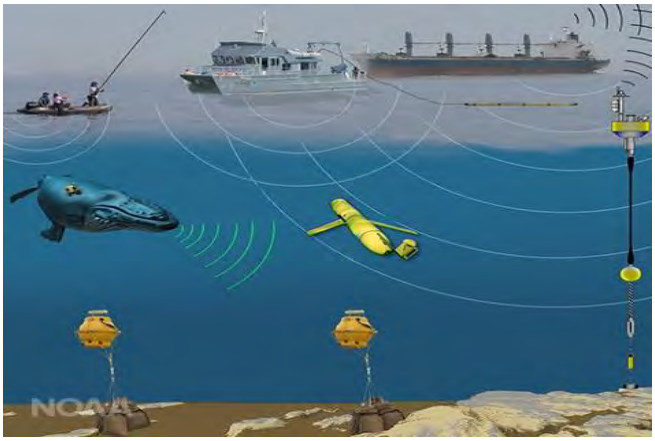
"The sounds whales make underwater are super cool, and also very important for them to locate prey, navigate and communicate with each other. We find out how they make those sounds and what scientists think they mean. We also learn how a blowhole is like a human nose. A human nose that talks."- from Molly Bloom of Brainson.org

-Review with the students the similarities and differences between the internal structures that humans have to produce sound, and the structures the whales have inside to produce sound.
-What other structures do whales have to help them breathe, feed and move through the water?

Hands-on Activities:
(15 minutes)

5. Introduction to waves: Show the students how waves work-

Select one student to hold end of rope while you hold the other. Move rope up and down to show how a wave moves. Experiment with different speeds and amplitudes (height). Select a few other students to experiment with doing this. Have students draw what they saw, or select a student to draw what they saw on the board. Explain that sound travels in waves.



Next, while two students are holding rope and making a wave, try to stand in the middle and grab the rope. The purpose of grabbing the rope is to demonstrate that if something gets in the way of the wave, it will STOP.

6. Play Sound Game in open space. (Trial 1)
-Select six students.
-Divide them into two groups of three.
Group A and B.
-Hand three students in Group A song strips.
-Hand three students in Group B song strips.
-Have Group A students stand shoulder to shoulder with one another facing Group B students, also standing shoulder to shoulder.
-There should be about 12 feet of distance between Group A and Group B.
Direct students to close their eyes, sing their song, and try to safely walk toward the person in the other group that is singing their same song i.e. their "partner" just by listening for their song. They should be able to find one another relatively easily, but it may be a bit of a chaotic environment.

7. Add variation (Trial 2):
-Choose 6 new students plus 5 additional (total 11 students) to repeat game with the same set-up. This is Trial 2.
-Hand out the "La La La" song strips to the group of five students and instruct them to sing those words "la la" as they walk between the groups while partners are trying to find one another.

Explain that this chaos is going on in the ocean right now. Their partners are the whales that are trying to sing to one another. Challenge the students to think about what the "La, La, La" sounds represent.

Possible answers: Oil rigs, giant container ships, military vessels.

Understanding:
(10 minutes)
8. Ask students: *How do ships create noise in the ocean?* Have students write down ideas and share them with the class.

Play second video:
Songs of Whales Drowned by Man Made Noise- SONIC SEA from Discovery Channel (subtitles available only in English.)

The first time, play it silently. After first viewing, have students brainstorm what they saw and make predictions about what the video is saying. Then, play video a second time- *with sound*.
-Ask students: *How did hearing this video change your understanding of noise pollution in the ocean?*

Solutions:
(**10 minutes)**
10. Play video: Ocean Noise Pollution -Discovery
(This video plays natural and unnatural sounds and has captions in English-no narration.)
-Have students brainstorm solutions for what could be done to protect whales. Write solutions on the board.

Assessment:
(10 minutes)
Pass out assessment sheet for students- "Helping Whales". Go over two-sided worksheet, and encourage students to add as much detail as possible.

Conclusion:
(5 minutes)
After giving students time to complete the worksheet, tell them national marine sanctuaries are working to research this issue and learn more about it. Show them a map of where national marine sanctuaries are and point out which ones are closest to us. Explain that these areas are like national parks, but in the ocean and are national treasures for us to protect and learn from. (See map here to show them where national marine sanctuaries are in the United States. https://sanctuaries.noaa.gov/) Show them this final video that explains how Cordell Bank National Marine Sanctuary is researching this issue. The video shows researchers working at sea with the instruments and interviews a scientist who explains why and how they are learning about the issue.

https://sanctuaries.noaa.gov/science/sentinel-site-program/cordell-bank/accoustic-buoy-final.html

Extension:
Have students research whales and other marine mammals at Cordell Bank National Marine Sanctuary that could be affected by noise in the ocean.

For More Information:
Humpback whales communicate through sound without vocal chords- CBS Evening News (no subtitles, only English.)

A recording of a humpback whale in Hawaii: https://nmshawaiihumpbackwhale.blob.core.windows.net/hawaiihumpbackwhale-prod/media/archive/explore/sounds/whale_song.mp3

NOAA

Credit and more information:
This lesson was developed by Karen Madden a 4th grade teacher in Marin County, CA after participating in a sanctuary teacher workshop including participating in a research cruise pulling up the hydrophone that is in the Cordell Bank National Marine Sanctuary.

If you have any further questions or need additional information, email cordellbank@noaa.gov.

Education Standards

Next Generation Science Standards	**Disciplinary Core Ideas:** **4-LS1-1 From Molecules to Organisms: Structures and Processes** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **4-LS1-2 From Molecules to Organisms: Structures and Processes** 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. **3-5 ETS1-2 Engineering Design** 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. **Science and Engineering Practices:** • Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematical and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information **Crosscutting Concepts:** • Patterns • Cause and Effect • Structure and Function Stability and Change
Ocean Literacy Principles	5. The ocean supports a great diversity of life and ecosystems. 6. The ocean and humans are inextricably interconnected.

Assessment Sheet:

Name_____ Date_____

Helping Whales

1. **What structure do whales rely on the most to communicate:**

   tail flippers ears eyes feathers

2. **How do whale sounds travel?**

   ripples waves noises drops flashes

3. **What functions do whales need to do in order to survive?**

reproduce communicate move eat eliminate waste

4. **Draw a picture of a whale, include the structures used to communicate, and labels these structures.**

Name_____ **Date**_____

5. **Can you list at least three reasons why there are more sounds in the oceans nowadays?**

1.

2.

3.

6. **Can you draw or write about a solution for how we can help whales?**

Hands on Demonstrations- Worksheet #1 (Page 1)

Sound Game:

Trial 1- **6** students

Cut out strips along black lines. Keep in two piles: Trial #1 Group A Trial #1 Group B

Trial 1 Group A Sing Alphabet Song	**Trial 1 Group B Sing Alphabet Song**
Trial 1 Group A Sing Mary Had a Little Lamb	**Trial 1 Group B Sing Mary Had a Little Lamb**
Trial 1 Group A Sing Old MacDonald	**Trial 1 Group B Sing Old MacDonald**

Trial 2- **6** students, plus **5** kids singing La La La to signify NOISE in ocean!

Cut out strips along black lines. Keep in two piles: Trial #2 Group #1, Trial #2 Group #

Trial 2 Group C Sing Alphabet Song	**Trial 2 Group D Sing Alphabet Song**
Trial 2 Group C Sing Mary Had a Little Lamb	**Trial 2 Group D Sing Mary Had a Little Lamb**
Trial 2 Group C Sing Old MacDonald	**Trial 2 Group D Sing Old MacDonald**

Trial 2 **Group E** **Sing La- La- La**	**Trial 2** **Group E** **Sing La- La- La**
Trial 2 **Group E** **Sing La- La- La**	**Trial 2** **Group E** **Sing La- La- La**
Trial 2 **Group E** **Sing La- La- La**	**Trial 2** **Group E** **Sing La- La- La**