

Listen!

Instructor Background

Even though humans and many other land animals depend on sight as the main source of information about the world around us, sound plays a very important supplemental roll in helping us define our environment. Some animals, especially those in the ocean, have gone the other way, and rely on sound, with sight being supplemental.

Adaptations to utilize sound over sight in the ocean are a definite advantage. Light travels fairly unimpeded through the atmosphere, but, due to the physics of water, light is rapidly absorbed within meters, effectively disappearing by 200 meters. If the water has a lot of material suspended in it, like plankton or sediment (turbidity), useful light may only exist in the first meter! Sound, on the other hand travels faster in water than in air. Depending on factors such as temperature, salinity and others, sound can travel almost 5 times faster in water.

Whales and dolphins have evolved to take advantage of how sound moves underwater. Mysticetes (whales with baleen instead of teeth, such as blue whales, humpback whales and gray whales) are capable of producing low frequency sounds for communication. A great example are the haunting sounds of humpback whale “songs”. Not all mysticete sounds are that cohesive or complex, which makes it difficult to distinguish from other ocean sounds. As technology advances, however, and our knowledge of the whales improves, we keep finding more and more information about these deep sounds.

Odontocetes (toothed whales, like dolphins and sperm whales) take their sounds to a whole other level. Odontocetes tend to make more high frequency sounds. These sounds don’t travel as far underwater as low frequency sounds, but can provide fairly detailed information of the local area in a process called echolocation. This allows sound waves generated inside the whale to pass out into the water and bounce off objects, sending echoes back. These echoes can provide information about size, distance, speed (if the object is moving) and even the material the object is made of. (Echolocation is also common in night flying bats, some birds, and even found in a few small land mammals)

In the last 200 years, humans have radically increased our uses of the world’s ocean basin, not only for travel and trade, but also for recreation and natural resources. This has increased the amount of noise in the ocean, often referred to as anthropogenic sound, or noise pollution. Much has been made of naval SONAR tests affecting whales over the last few years. This is critical and tragic, but is only part of the problem. Undersea explosions used in mining and mineral detection can be just as damaging as the SONAR tests. All the additional sounds from recreational craft along the coast can confuse echolocation using animals that utilized coastal feeding grounds (think about trying to drive with someone constantly flashing lights in your eyes). It has been found that the engine noise from cargo ships and tankers can fall into the same frequency

range as the calls of some of the great whales (like blue and fin whales) which can mask or disrupt those calls (think of several radio stations broadcasting on the same frequency). Since it has been discovered that the low frequency sounds these whales make can, under the right conditions, travel thousands of kilometers, ships traveling on one side of an ocean basin can adversely effect whales on the other side of that basin!

The purpose of this activity is to get students to think about how sound plays an important role in gathering information about the world around us. Understanding how we as humans utilize sound in defining our environment can lead to a better understanding of how other animals use sound, and how important it can be to them. It can also help students realize how humans can affect animals and ecosystems in un-obvious ways.

Glossary

Anthropogenic – Created or caused by human activity

Echolocation – The process of using reflected sound wave to determine the position of an object or objects.

Mysticete – Any of the group of whales Mysticiti, that are in part characterized by a complete lack of teeth, instead possessing rows of keratin plates called baleen growing from the roof of their mouth.

Odontocete – Any of the group of whales Odontoceti, that are in part characterized by possessing teeth in one or both of their jaws.

Listen!

Investigation #1

Find a comfortable place to sit. Set a timer for 20 seconds. Close your eyes (or use a blindfold if you think you would be tempted to peek) and start the timer. Quietly listen. When the timer goes off, open your eyes and write down at least one thing you heard. Repeat 2 more times and write down something different you heard each time.

*Do you feel it is easy or difficult to identify sounds when your eyes are closed?
Was it easier to tell sounds apart on the third try than on the first?
Were there sounds that you couldn't identify with your eyes closed?*

Have a partner help you with the next three parts.

Investigation #2

Find a comfortable place to sit again. Set the timer for 30 seconds. Close your eyes (or use a blindfold if you think you would be tempted to peek) and start the timer. Quietly listen. See if you can tell what your partner is doing just by listening. PARTNER: Pick an activity to do that makes some noise. Examples – walk around the room, slide things on the floor or table, eat something crunchy; use your imagination! Exchange places and repeat 2-3 times.

*Were you able to guess what your partner was doing?
What sounds did you hear that helped you identify what your partner was doing?*

Investigation #3

While standing, put on a blindfold/eye mask. Have your partner safely guide you around, ideally walking through different parts of your home. Exchange places and repeat.

*As you move around your home, can you notice when you move from one room to another, or enter a hallway?
Did different areas sound different? Is so, can you describe the difference?*

Investigation #4

While still blindfolded, have your partner position you about 1 meter (about 3 feet) from a wall or door. Slowly lean forward until your forehead gently touches the surface. Be sure your partner doesn't let your head hit the surface! Exchange places and repeat.

Did you notice any differences in sounds as your face got closer to the wall?

Background

Sound is a very important part of our world. Humans tend to rely mostly on sight as our main source of information, but we get much additional information about our surroundings from sound.

In the ocean, since light doesn't penetrate very deeply into the ocean (no more than 200 meters at best), animals have adapted to use other ways to learn about the world around them. Dolphins and whales have developed very sophisticated ways of using sound to communicate and learn about their surroundings. Baleen whales (mysticetes) use low frequency sound to communicate over extremely long distances, perhaps even across the Atlantic Ocean Basin! Dolphins and other toothed whales (odontocetes) use high frequency sounds to get fairly detailed information of their immediate area in a process called echolocation. By emitting sounds and listening to the echoes as those sounds bounce off objects, they can "see" what is around them, even in total darkness.

Can you think of any other animals that might use echolocation?

Believe it or not, humans have, in some cases, developed a form of echolocation. Sounds help blind people to navigate in their local environment, and some have even improved on this, by making their own noises (usually clicking sounds with their mouth) and using the echoes to enhance their awareness of what is around them.

In the last 200 years, humans have steadily increased the amount of sound in the ocean through shipping and other activities. This is referred to as anthropogenic sound, or noise pollution. Too many unfamiliar sounds, an increase in loud noises, even sounds that are similar to ones that other animals make can cause confusion to ocean animals that rely heavily on sound to understand their environment. (Think about the times it's been too loud or too noisy for you to concentrate.)

Make a list of different ways you think humans may be creating noise in the ocean. In what ways do you think anthropogenic sounds can affect ocean animals, especially sound dependent animals like whales and dolphins?

Extensions:

Repeat these activities outside if possible. Be extra aware of safety when outdoors!

Is it harder to distinguish sounds outside than it is inside?

Do this activity daily/several times a week.

Does it get easier to pick out sounds the more you do this?

Redo Investigation #3, this time making a clicking sound with your tongue every few seconds.

*Did you notice any differences on this trial then when you did it silently before?
If you noticed differences, try to describe them.*

Redo Investigation #4, this time making a clicking sound with your tongue every few seconds.

*Did you notice any differences on this trial then when you did it silently before?
If you noticed differences, try to describe them.*

If ear plugs are available, do similar activities, but with eyes open and ear plugs in.

*Note any differences in moving around with sound absent or greatly reduced.
Was it uncomfortable to move around without being able to hear properly?*

Additional Resources and Information

What is echolocation and which animals use it?

<https://www.discoverwildlife.com/animal-facts/mammals/what-is-echolocation/>

Test your ability to navigate by echolocation

<https://www.youtube.com/watch?v=m8-BvWIRh5g>

Marine Mammal Laboratory

<https://www.afsc.noaa.gov/nmml/education/cetaceans/cetaceaechol.php>

Whales echolocate with big clicks and tiny amounts of air

<https://www.sciencenewsforstudents.org/article/whales-echolocate-with-big-clicks-and-tiny-amounts-of-air>

Whale Sounds

<https://www.tepapa.govt.nz/about/touring-exhibitions/whales-tohora/whale-lab/whale-sounds>

Marine Mamma vocalizations: language or behavior?

<https://www.whoi.edu/science/B/people/kamaral/marinemammalacoustics.html>

Just like bats, humans can use echolocation

<https://phys.org/news/2018-04-humans-echolocation.html>

Human echolocation – Daniel Kish, “Batman”

<https://www.youtube.com/watch?v=A8lztr1tu4o>

Blue Whales and Communication

<https://www.nationalgeographic.com.au/science/blue-whales-and-communication.aspx>

Ocean Uproar: saving marine life from a barrage of noise

<https://www.nature.com/articles/d41586-019-01098-6>