INTRODUCTION

In the ocean, light is absorbed and does not travel very far from the surface, leaving much of the ocean dark. For marine mammals however, their 3 dimensional world is illuminated by sound, which travels much farther than light underwater. Whales use this to their advantage, using sound not only as a means of communication, but as a way to “see” their surroundings and find food.

What is Echolocation?

Toothed whales - such as dolphins, porpoises and orcas - make clicks that are used for echolocation. These whales will produce a sharp, impulsive sound like a clapping hand resulting in sound waves that bend, and bounce off of objects in the water. Whales are able to interpret the echoes from that click to form a 3-dimensionnal picture of its environment. Ultrasounds mimic this technology to create a sonogram of an infant in the womb. High frequency clicks give a large amount of detail and can even be used to investigate the inner layers of certain objects, like fish. Low Frequency clicks give a much less precise image, but can be used across greater distances.

How do they do it?

The clicks are emitted in the head region and focused by the melon. The received echoes pass through special sound conducting tissue in the lower jawbone to the inner ear.

Scientists do not agree about where the sound comes from. Some scientists suggest that sound is emitted from a nasal plug and that the shape of the melon is altered by muscles to focus sound. Other scientists believe that the larynx emits sound and argue that echolocation focusing is achieved by bouncing sound off various parts of the skull.

How sensitive is echolocation?

Echolocation is extremely sensitive. For example, dolphins in aquariums can distinguish between objects that are the size of a B-B pellet and a kernel of corn (each less than 1/2 an inch (1.27 centimeters) in diameter) at about 50 feet (15.2 meters) away.

Taken from NOAA:
http://www.afsc.noaa.gov/nmml/education/cetaceans/cetaceaechol.php#what

TAKING IT FURTHER
Watch this short video of visually impaired people that are able to echo-locate.

OBJECTIVES

To understand that marine mammals have unique structures that enable them to receive and process sound waves to create a three dimensional picture of its environment.

To understand that marine mammals use different sound as means for finding food, navigating, and communicating.

To be aware of how human noise can interfere with these abilities.

NEXT GENERATION SCIENCE STANDARDS

Kindergarten
k-ESS3-1, k-ESS3-3

Grade 1
1-PS4-1, 1-PS4-2

Grade 2
2-LS2-2

Grade 3
3-LS2-1, 3-LS4-3

Grade 4
4-PS3-2, 4LS1-1, 4-LS1-2

Middle School
MS-PS4-2, MS-LS1-8
INTRODUCTION ACTIVITY - Click and Seek

Materials: Blindfolds
Clickers or squeakers (optional)

Instructions: Pair up students and give one student a blindfold and one student a clicker. Have the students with the clicker navigate the blindfolded student around the room or space using only the clicker (no words). The clicker will walk backwards to watch the follower to make sure they follow safely. The blindfolded student will have to listen to and follow the direction of the clicks. Then have them switch. Students may want to try coming up with their own code, like a double click means stop, 3 clicks means they need to step over something, like a bump.

Discussion:
- Is it easy to follow the clicking noises?
- What is difficult about it?
- Are we adapted to interpret noise in the same way that dolphins are?

ADDITIONAL ACTIVITY - Marco Echo

Materials: Blindfolds, Clickers and squeakers (optional)

Instructions: This game is a variation of Marco Polo. Assign 2 or more students to be dolphins, the rest of the students are fish. The dolphins are blindfolded to mimic the lack of light in the ocean. Make sure the area is free of obstacles and have some of the students keep a perimeter where the dolphins will be safe when they are blindfolded. If you need to make the dolphins safer, you can let them peek out the bottom of the blindfold so they don’t trip.

The dolphins start together as a pod. In nature, pods help each other hunt by corraling the fish. The dolphins will use echolocation to find their fish in the dark. Encourage the students who are dolphins to work together. The fish do not want to be eaten (tagged) by the dolphin and will scatter.

Dolphins will call out “echo” and all the fish respond and call out “locate” or the dolphins call with the squeaker and fish respond with the clicker. The dolphins will use this to track down fish. Dolphins may also talk to their pod mates in order to work together.

Once the fish are tagged, have them move to the side. After the dolphins have caught 4-5 fish, have the eaten fish go back into the game and mimic shipping noise or the booming from gas exploration. The dolphins and fish will try to avoid these new threats while they hunt for food.

Discussion:
- How easy was it for dolphins to find food before the ships?
- How easy was it for fish to get away?
- How did this change when shipping noise was added?
- How do you think shipping noise affects marine mammals like dolphins?
- What can you do to help?