Acoustical Society of America

Echolocation and SONAR: Echolocation WrapUp

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Students go through a powerpoint that puts the echolocation topics together and helps them understand *why* and *how* echolocation works.

This activity should be done after Sound Rather Than Sight and How Dolphins Hear Sound. Having done the Speed of Sound Activity will also help understanding.

Science Topics	Process Skills	Grade Level
Echoes Echolocation Speed of sound	Observing Predicting Scientific Inquiry Comparing Classifying Communicating	2-12

Time Required			
Advanced Preparation	Set-Up	Activity	Clean-Up
Gather materials	5 minutes	25-40 minutes*	5 minutes

*The amount of time spent on this lesson depends on whether you've already taught the Doppler effect lesson, and on how long you spend discussing the various jobs in acoustics.

Learning Goals

Students will be able to

- Describe what an echo is and how it's created at the sound wave level.
- Describe how our ears or a dolphin localizes sounds.
- Describe several different types of acousticians and give examples of what they do in their jobs.

Materials

- Power Point

Doppler Effect

- Computers*
  - "Sound" simulation from the PhET.colorado.edu site

Please forward any questions or comments to:
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*If there aren't enough computers for every student and the computer lab isn't available it's possible for the sound simulation activity to be done as homework or a teacher demonstration.

Advanced Preparations

- Gather materials

Set Up

- Set up the computer/projector to present the power point.

Introducing the Activity

Explain that the class will be looking at a power point that talks about the echolocation and sound ideas they've been learning about.

Doing the Activity

Doppler Effect- Sound Simulation*

*If you have already completed the Doppler effect activity, skip this section and move on to the echolocation powerpoint.

Students will work through the following questions using the sound simulation. When they are finished they should have drawn a total of three different sound waves.

1. Look at the "Sound" simulation on the PhET.colorado.edu site. Investigate how the wave changes as you adjust the various parameters.
2. Pick at least two parameters and describe how each one changes the wave.
3. Draw a picture of a sound wave below.
4. Draw a wave that is a low sound and one that is a high sound. What is different between the two?

Have a class discussion about what the students have noticed.

Echolocation Power Point

Slide 2

Ask the class what sound does when it hits the barrier.

- Show them the picture in slide two or the tab on the sim where it says "barrier"

Slide 3 – Listen for echoes

- Echolocators listen for the sounds bouncing back
- Most produce their own sounds (such as clicks) and listen for them to come back.
- People do this subconsciously

Slide 4
Before showing the slide, remind students about the sound rather than sight activity. Ask students to explain how it felt to identify objects beside them vs. objects in between their feet. Ask which of these to tasks was the hardest, then ask them why they think this is.

Show slide four, which shows how sound gets to one ear before it gets to the other ear.

The brain automatically knows this. It tells you what side the pen dropped on because one side hears the sound first.

- Show the sound sim to demonstrate the delay, which shows how the sound waves hit one ear before they hit the other.

Slide 5 – Listen for the Delay
- The delay tells the brain how far away an object is.
- If one ear hears it first, then it knows the object is on that side.
- This is how dolphins and bats know how far away their prey is!

When students watched the sound, it had to get to the barrier then come back again. The students should come to the conclusion that sound isn't instant.

Slide 6 – Speed of Sound
Sound travels through the air, and there's a delay between when you see something and when you hear it. Sound travels at different speeds through things; slowest through air, faster through water, and also through water. This is why we can hear our neighbors music through the walls. It takes sound:
- approximately 5 seconds to travel a mile in air
- approximately 1 second to travel through water
- approximately ¼ of a second to travel through rocks (granite)

When dolphins use echolocation the delay is ¼ as much as bats, which means that dolphins are more efficient hunters than bats.

Slide 7- Career Profiles
The goal of this activity is to talk about these people as professionals. This is to help kids realize that these careers are an everyday career similar a banker, a lawyer, or a police man. Scientists are not always someone who is famous like Marie Curie. Science is an attainable, every day career.

Point students to the explore sound website for definitions and people who do the following jobs:

- Architectural acousticians
- Instrument makers
- Concert hall designers
- Speech scientist
- Hearing specialist
- Medical acoustics
- Animal bioacousticians
- Underwater acousticians

Explanation

In-depth background information for teachers and interested students

Key Terms:

- Echoes – Reflections or repetitions of sound waves. Echoes can be produced and heard by clapping hands or shouting in a large empty room with hard walls or in a cave for example.
- Echolocation – A method used to detect objects by producing a specific sound and listening for its echo.
- Speed of Sound – The speed at which sound travels. This is very important for scientists who study sound. In air sound travels 343 meters in 1 second (767 miles per hour), but in water sound travels 1500 meters in 1 second (3350 miles per hour). Compare these speeds to cars traveling on the highway at 65 miles per hour.
- SONAR – Sound Navigation And Ranging, is the process of listening to specific sounds to determine where objects are located.

Optional Extensions /Modifications

Optional Extensions:

- Give three career profiles to the class and have them answer the following questions:
    - What's in common regarding what they do as scientists?
    - What's common about the advice they give to students?
    - How do these scientists get to where they are today?
- After the students have looked at the profiles, discuss them with the class.