Acoustical Society of America

Echolocation and SONAR: Speed of Sound and Identification from a Distance

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Students explore the speed of sound by experiencing the delay for sound to reach them when they know a noise has been made. They will explore what it feels like to identify objects from a distance.

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ASA Activity Kit Committee

This activity can stand-alone or be done in correlation with other echolocation activities. We used it on the same day as the Fish Finding activity.

Science Topics	Process Skills	Grade Level
Echoes Echolocation Speed of sound	Observing Predicting Scientific Inquiry Comparing Classifying Communicating	1-2

Time Required

Advanced Preparation	Set-Up	Activity	Clean-Up
Gather materials	15 minutes	35 minutes*	10 minutes

*35 minutes leaves enough time to get to and from the field. If you're escorting younger children, the activity may take up to 50 minutes.

Learning Goals

Students will be able to

- describe that there is a delay between when they see a sound happen and when they hear it.

Materials

- Additional Supervision*
- A very large field 200 yards or bigger (twice a football field)
- A rock and a metal post
- 7 different objects
- Identification from a Distance Chart (page 5)

Please forward any questions or comments to:
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*The class will be far enough away from the teacher that additional adult supervision will be necessary

Advanced Preparations

- Gather materials (see materials list)

Set Up

- Set up the field with landscaping flags (or other eco-friendly markers) every twenty large paces from the metal pole (or every 20 meters) until you reach 100 meters, then place another marker at the 200 meter mark.

Introducing the Activity

Explain that the class will be going outside and identify any safety concerns that may exist.

Doing the Activity

Speed of Sound

The class will travel to a nearby field.

1. Ask the class why you think you can see fireworks before you hear the boom.

The assistant should walk to a post that's 200 meters away from the rest of the class (the length of two football fields). It's very important to be this far away to show the delay of the sound. We tried 100 meters, and the delay wasn't large enough.

With a large arm motion, the assistant will strike a metal post with a rock. The assistant should do this several times (at least ten). It's helpful to prearrange a signal for the assistant to know when to stop hitting the post.

☆ Discuss the following questions with the class:

2. Do you hear the sound at the same time that you see the rock hit the post?
3. Why do you think this is?
4. How can you tell how far away lightening is?

5. Briefly demonstrate the calculation for the speed of sound. The speed of sound in air in Colorado is about 750 miles per hour. Calculate how many seconds it takes sound to travel 1 mile (time = distance / speed).

Question 5 solution:

Speed (v) equals distance over time. $v = \frac{x}{t}$

so $t = \frac{x}{v} = \frac{1\ mile}{750\ miles\ per\ \square our} = 0.00133\ \square ours$

$0.00133\ \square our\ \frac{3600\ seconds}{1\ \square our} = 4.8\ seconds \sim 5\ seconds$

Sound takes about 5 seconds to travel 1 mile in air.

This is where the rule of thumb comes from that says for every five one-thousands that you count, the lightning is a mile away.

Identification from a Distance

Students should go to a point that is 100 meters away from the metal post, which is halfway across the field. Explain that at this distance – using echolocation - a dolphin can identify small fish (6 inches in length) and some bats can identify a certain type of moth (1.25 inch wingspan).

The assistant will hold up 7 items one at a time. For question 6 the students will try to discern what each of the seven items are, and write their best guess down in their chart, even if it's just the color. After they've seen each of the seven objects the students will walk to 80 meters and the process will repeat, then the same for 60 meters, 40 meters, and 20 meters. The assistant should hold the seven objects up in the same order each time.

As soon as the students think they know what the objects are, they will circle the word in their chart under that distance.

For example, they figure out object 1 is a fish at 40 meters, circle the word fish in the 40 meter column circle.

Item	100 meters	80 meters	60 meters	40 meters	20 meters
1	blue	blue stick	blue toy	blue fish	

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

Modifications:

- Hard of hearing students will not be able to tell the difference between when they see the rock hit and when the sound reaches the class, so other students could raise their hands when they hear the sound. This way the student can still tell that there is a difference between when a sound is created and when it reaches a specific location.

Optional Extensions:

- Play the Fish Finding Game
- Complete the Sound Not Sight activity (if you haven't already!)
- Complete the other activities in the Echolocation Unit

Name _____

Quick Facts: *A bat can identify a mosquito within 3 meters (15 feet!)*

Item	100 yards	80 yards	60 yards	40 yards	20 yards
1					
2					
3					
4					
5					
6					
7					

Quick Fact: *Dolphins can make out an echo only 3 meters or 15 feet from an object. The speed of sound in water is 4.5 times faster so the echo is 4.5 times sooner!!*