Echolocation and SONAR: Speed of Sound and Identification from a Distance[1]

Adams, W. K.

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.

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

Time Required

Preparation	Set-Up	Activity	Clean-Up
See advanced preparation	15 minutes	45 minutes*	10 minutes

*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

In the Kit	Not in the kit
Identification from a Distance Chart (page 4) for each student	Additional Supervision* A very large field, 200 yards or bigger (twice a football field) A rock and a metal post 7 different objects 6 landscaping flags (or other markers)

*Since students will be outside and spread out, you might want to have extra supervision.

Advanced Preparations

Gather materials (see list above).

Set-Up

Label the 7 different objects with numbers 1-7. Set up the field with landscaping flags (or other eco-friendly markers) every twenty large paces (or every 20 meters) from the metal pole until you reach 100 meters, then place the last maker at the 200-meter mark. Leave that rock, and 7 objects next to the metal post.

Introduce the Activity

[1] 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.

Edited by Kelseigh Schneider & Keeta Jones
Reviewed by: American Association of Physics Teachers
Physics Teacher Resource Agents
ASA Activity Kit Committee

Explain that the class will be going outside for this activity. You should also identify any safety concerns that may exist.

Doing the Activity

Speed of Sound

1. The class will travel to the field set up with the markers. Have the students stay 200 feet away from the metal post.
    a. Ask the class why you think you can see fireworks before you can hear the boom.

2. The assistant should walk to the metal 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 sound.

    NOTE: We tried 100 meters and the delay wasn't large enough.

3. With a large, visible arm motion, the assistant will strike the metal post with a rock. The assistant should do this at least 10 times. It's helpful to prearrange a signal for the assistant to know when to stop hitting the post.

4. Discuss the following questions with the class:
    a. Do you hear the sound at the same time that you see the rock hit the post?
    b. Why do you think this is?
    c. 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).

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

$$\text{so } t = \frac{x}{v} = \frac{1\ mile}{750\ miles\ per\ hour} = 0.00133\ hours$$

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

Sound take 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 lightening is a mile away from you.

Identification from a Distance

1. Students should go to a point that is 100 meters away from the metal post, halfway across the field. They should create an Identification from a Distance chart (see below for an example) and a writing utensil.

2. Explain that at this distance – using echolocation – a dolphin can identify small fish just 6 inches in length and some bats can identify a certain type of moth with a 1.25-inch wingspan!

3. While the students are still 100 meters away, the assistant will hold of the 7 objects one at a time, in order. Students will look at each object and try to discern what each one is and write down their best guess on the chart, even if it's just the color. After they have done this for all 7 objects from 100 meters away, students will up to the 80-meter mark and repeat the process. Then the same for 60 meters, 40 meters and 20 meters. The assistant should hold up the 7 objects in the same order each time.

4. As soon as the students think they know for sure 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, circler the word "fish" in the 40- meter column.

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 Lesson Terminology

- 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 (747 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.

Optional Extensions

- Play the Fish Finding Game
- Complete the Sound Not Sight activity
- Complete other activities in the Echolocation Unit

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 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.

Supplemental Materials

Identification from a Distance Chart below on page 5.

Speed of Sound

Name _____

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

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

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