



Echolocation and SONAR: Speed of Sound

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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 and to find objects without sight.

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ASA Activity Kit Committee



This activity can stand-alone or be done in correlation with the [Echolocation Part 2](#) activity.

Science Topics	Process Skills	Subject Integration	Grade Level
Echoes	Observing	Physical Science	1-12
Echolocation	Predicting	Biology	
Speed of sound	Scientific Inquiry	Animal Bioacoustics	
	Comparing	Psychological &	
	Classifying	Physiological Acoustics	
	Communicating		

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.
- name several animals that use echolocation and SONAR to find food or objects.
- describe the limits of the size and distance that dolphins and bats can echolocate.

Materials

- Packets – 1 per student (pages 5-7)
- Additional Supervision*
- A very large field 200 meters (~200 yards) or bigger (twice a football field)
- A rock and a metal post
- 7 different objects

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 may be necessary

Advanced Preparations

- Gather materials (see materials list)

Set Up

- Set up the field with landscaping flags (or other 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

Students will answer question 1 in their packets to get them thinking about the speed of sound. 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. 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.

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.

The students will then answer questions 2-5.

Question 5 solution:

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

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

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



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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-thousand’s that you count, the lightning is a mile away. (“1 one-thousand, 2 one-thousand, 3 one-thousand...”)

Identification from a Distance

Students should go to a point that is 100 meters away from the metal post.

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. (Item 1 of 7 is shown below).

Item	100 meters	80 meters	60 meters	40 meters	20 meters
1					

The students will walk to 80 meters and the process will repeat, then the same for 60 meters, 40 meters, and 20 meters. As soon as the students think they know what the objects are, they will circle the word in their chart under that distance.

Fish Finding

Groups of 8-10 students will work together for this section. One student will be a dolphin, 3 will be fish, and 4 will be objects. Additional students will be fish or objects.

Fish finding

Two smaller groups will combine for this activity for a total of 8- 10 people working together.

Have one person be the dolphin, four people will be objects and three will be fish.

- The dolphin *must* keep their eyes closed the whole time.
- Objects are to lay, sit or stand in one place.
- Fish move around *slowly*, winding in and out of objects.

The dolphin tries to locate a fish.

- The dolphin makes a sound, “beep,” and any object or fish in front of the dolphin is required to respond.
 - Objects will say, “object”
 - Fish will say, “fish”
- When a fish is tagged, that fish becomes the dolphin.

(Optional Idea: If the dolphin is having trouble locating fish or if the fish are misbehaving, have the fish move one step per beep or simply have them stand still)

After playing the game, students should answer questions 7 and 8.

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 ~340 meters in 1 second (760 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:

- Younger students will not fill out the worksheets as they complete the activity.
- 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.

Finding Fish

- If the dolphin is having trouble locating fish or if the fish are misbehaving, have the fish move one step per beep or simply have them stand still
- This activity provides a role for every student.

Optional Extensions:

- If there is extra time, students can switch roles in the Fish finding game and play from a new perspective.
- Complete the [Sound Not Sight](#) activity (if you haven't already!)



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Echolocation and SONAR Speed of Sound

Name: _____

Echoes

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!!*

Speed of Sound

1. Why do you think you can see fireworks before you hear the boom?

Stand the farthest point from your instructor and listen while your instructor hits a metal post with a rock. We will be set up 200 meters (approximately 200 yards) apart – that's two football fields.

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 lightning is?

5. The speed of sound in air is about 340 meters per second or 750 miles per hour. Calculate how many seconds it takes sound to travel 1 mile (time = distance / speed).

Identification from a distance

Move halfway towards your instructor (100 meters away). *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).*

6. Identify the objects being hold up and fill in your best guess, even if it’s just the color. Circle the object when you “know” you have it figured out. For example at 40 meters if you figured out that one object is a fish. In the 40 meter column circle the word fish.

Once you’ve seen all 7 objects, move up to the next marker which will be 80 meters. Identify the 7 objects again. Etc...

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

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

Fish finding

Two groups will combine for this activity for a total of 8- 10 people.

Have one person be the dolphin, four people will be objects and three will be fish.

- The dolphin **must** keep their eyes closed (no cheating!!).
- Objects are to lay, sit or stand in one place.
- Fish move around *slowly* winding in and out of objects.

The dolphin tries to locate a fish.

- The dolphin makes a sound, “beep” and any object or fish in front of the dolphin is required to respond.
- objects will say, “object”, and
- Fish will say, “fish”.

Once the dolphin touches a fish, that fish becomes the dolphin.



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(*Optional Idea:* If the dolphin is having trouble locating fish or if the fish are misbehaving, have the fish move one step per beep or simply have them stand still)

7. What can the dolphin do to make their job of fish finding easier?

8. Does it help if they beep more often?