

# **Acoustical Society of America**

# Echolocation and SONAR: Sound Rather Than Sight Adams, W.K.

Edited by: Kelseigh Schneider Reviewed by: American Association of Physics Teachers Physics Teacher Resource Agents ASA Activity Kit Committee In this activity students explore the idea of how it feels to use sound to locate objects and experiment with having to search for objects above and below them, not just side to side.

This activity can stand-alone.

Science Topics	<b>Process Skills</b>	Subject Integration	Grade Level
Sound	Scientific Inquiry	Physical Science	4-12
Echolocation	Observing	Biology	
SONAR	Measuring	Animal Bioacoustics	
Vision impairment	Comparing	Psychological &	
	Inferring	Physiological Acoustics	
	Communicating		
<b>Fime Required</b>			
Advanged	Sat Un	Activity	Clean Un

Advanced	Set-Up	Activity	Clean-Up
Preparation			
Gather materials	15-20 minutes	50 minutes	10-15 minutes

# **Learning Goals**

Students will be able to

- define SONAR and Echolocation and give examples of several animals that use these tools.
- Explain the difference between locating food that is on the ground versus all around such as up in the air or if we were swimming above, below and side to side.

## Materials

- Homework (pages 8-10)
- Packet for each student (pages 5-7)

### Sound Rather Than Sight

- Blindfolds 1 per group
- Cotton balls
- Pencil, dry erase markers, etc
- Rulers 1 per group

#### **3D** Location

- Buttons ~15 (variety of shapes, sizes, and colors)
- String
- Laser pointers\*
- Flashlight (narrow beamed)
- Additional Adult supervision\*\*

\*Laser pointers work better than a flashlight, but a flashlight can be substituted if necessary. The narrower the beam of light, the better.

\*\*An additional adult may be useful for the 3D Location section, particularly if the students need to go to another room in the building.

### **Advanced Preparations**

- Prior to the lesson students should complete the homework assignment on pages 8-10
- Gather materials
- Attach string to a variety of buttons. Make the strings a range of lengths.

### Set Up

- Prepare materials for students to collect
- Hang a variety of buttons from the ceiling of a room with no windows or lights. The buttons should be hung at different heights.
- Place a piece of tape or rope across the doorway so students can't enter the room.

# **Introducing the Activity**

Students will turn in their homework assignments from the night before.

Explain that in the following lesson there will be two activities. One will be using sound rather than sight, and the other will to use a laser pointer to find objects around a dark room. Introduce both activities so students are aware of what they are doing.

## **Doing the Activity**

\*While all students are working on the Using Sound Rather than Sight section, small groups will be going into a dark room to complete the 3D Location section.

#### **Using Sound Rather than Sight**

Students will divide into groups of 3 -5. One student will wear blindfolds so that they are entirely blind (we put cotton balls under the blindfold on the eyes so students can't peek under the blindfold) and another will drop an object on the floor. The blindfolded student has to guess

a. What object fell and

b. Where they think the object fell (by placing their hand down directly- not by fishing!).

The students should try dropping the objects at different locations around the room, including behind the blind folded person and between their feet.

They will measure the distance between where the blindfolded person guessed and where the object actually fell.

Students do this five times and then switch positions.

110 0110	is they do the experiments, they should fill out end to similar to this.				
Drop	Item dropped	Guessed item	How far off	Where dropped	Where guessed
1	Pencil	Marker	36 cm	Half a meter on their right side on the floor	15 cm to the right of their feet

As they do the experiments, they should fill out charts similar to this:

Have the class answer questions 1-6 in their packets.

#### **3-D Location**

Explain that animals use echolocation in the water and the air. Ask the class to come up with animals that use echolocation in these two areas.

Ex. Bats and dolphins

Explain that in our world we are typically only concerned with 2 dimensions, but echolocators have to look up and down as well as left and right, so they are dealing with 3 dimensions.

One group of 3-5 students at a time will go into a completely dark room. Using a laser pointer, they will try to identify as many objects hanging from the ceiling as possible.

• Students should try and look for the objects themselves- not the strings attaching them to the ceiling! Bats and dolphins don't have strings to use when searching for food.

Students will then answer questions 1-2 in their packets.

### **Explanation**

In-depth background information for teachers and interested students

People have a harder time locating objects right between their feet or directly in front or behind them. Our brains are able to detect the time delay for sound arriving at each ear. Using this delay our brain determines to which side the object fell and how far away it is. When an object is right between our feet or directly in front or behind, the sound arrives to each ear at the same time.

### <u>Key Terms:</u>

- Echolocation A method used to detect objects by producing a specific sound and listening for its echo.
- 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 can be the recorders/measurers
- When doing this activity in the lower grades, teachers can control the laser pointer while students search for buttons. Most laser pointers sold today are safe for kids check the packaging.

### **Optional Extensions:**

- In the 3D location activity, students can try using a flashlight after they have used the laser pointer to see if the activity is easier.
- Conduct the <u>Speed of Sound</u> activity (if you haven't already!)

#### **Echolocation and SONAR**

Name:

#### Using Sound Rather than Sight.

One person wears the blindfold (do not cheat!). Stuff cotton balls under the blindfold below the eyes. The other person drops a pencil somewhere on the table or floor. The blindfolded person gets one chance to grab the object. They cannot *search* with their hands! Leave your hand where you grabbed. The other person measures how far off the grab is from the object with a ruler.

Now drop either the pencil or a pen/dry erase marker in a new spot. The blindfolded person must identify what was dropped and puts their hand where they think it is. Do this four more times.

Note: Make sure that sometimes it's behind them or between their feet!

Person1:					
Drop	Item dropped	Guessed item	How far off	Where dropped	Where guessed
Example	Pencil	Marker	36 cm	Half a meter on the right side on the floor	15 cm to the right of their feet
1					
2					
3					
4					
5					

Person 2:

Drop	Item dropped	Guessed item	How far off	Where dropped	Where guessed
1					
2					
3					
4					
5					

- 1. What location was the easiest to identify?
- 2. What location was the hardest?
- 3. Describe the mistakes for each location:
  - a. Close
  - b. Far away
  - c. Medium distance
  - d. Behind the person
  - e. Table
  - f. Floor
  - g. Between the feet
- 4. Did you get better?
- 5. How much practice do you think you'd need to be able to actually find objects?
- 6. How much practice do you think you'd need to identify objects 30 meters away? (Remember By this complex system of echolocation, dolphins and whales can determine size, shape, speed, distance, direction, *and even some of the internal structure* of objects in the water.)