

# Echolocating with Dolphins (Seated Game)

Name: **Teacher Guide**

Date: \_\_\_\_\_

Answers will vary. We have provided examples of possible answers and ideas of what to look for in students' thinking.

## Instructions:

1. Gather your other materials to use echolocation! (Colored Markers, Blindfold, Measuring tool (such as ruler or tape measure), Timer, *Optional*: Internet access and speaker to play sounds)

2. Animals have senses (such as the use of sound, sight, smell, taste, and touch) that have adapted to the environment where they live. Discuss and answer with your classmates:

a. How do you use your senses in your daily life?

Look for students to reflect on multiple senses and to give specific examples of how they use their senses to navigate the world around them. For example, the use of sight to identify friends, to find their way around, and to read; the use of smell to identify if food is fresh or spoiled, to smell the ocean; the use of touch to know if something is too hot or too cold; the use of sound to know if a car is coming.

b. How do animals use these senses differently than humans? (*Hint: think about observations you've made of your own pets*).

Look for students to make observations about real life and to reflect on the difference in sensitivity and importance of senses between types of animals. For example, dogs rely largely on the sense of smell and are much better at smelling than humans; cats use their sense of sight well and are better at seeing in the dark; birds use their sense of hearing and make elaborate calls and songs; fish use their lateral line (a sense that humans do not have) to detect motion in the water and "feel" other fish in their school.

3. Read the background information below:

Animals receive information through their senses, process information in their brain, and then respond. The better an animal can sense and respond to its environment, the more likely it is to survive and reproduce.

The use of sound is a powerful sense underwater.

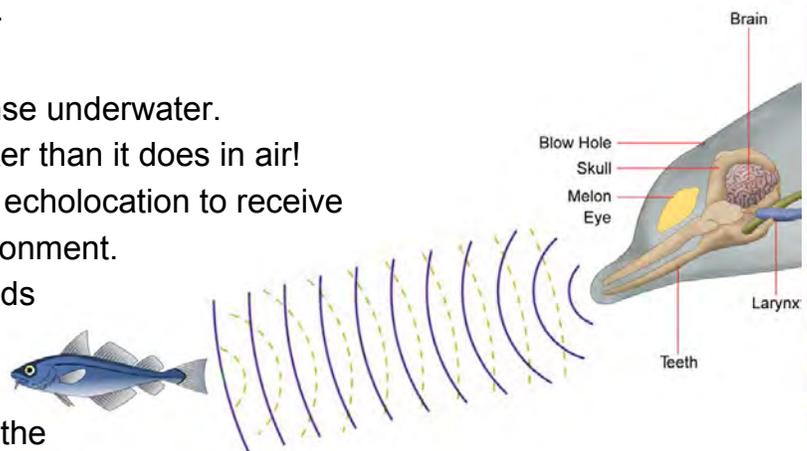
Sound actually travels faster in water than it does in air!

Toothed whales, like dolphins, use echolocation to receive sound information about their environment.

To use echolocation, a dolphin sends out a series of clicks. The sound vibrations then bounce off of an object and return, or echo, back to the dolphin (Fig. 2).

These echoes are processed in the dolphins brain to create an 'image' that gives information about the distance, shape, and characteristics of the object. This allows dolphins to 'see' further than their eyes are able.

Dolphins rely on echolocation to find prey, but they also produce and use other sounds to communicate with one another. Dolphins can make a range of sounds that differ in frequency and pitch. The sounds dolphins use to communicate are generally lower pitched whistles. Individual dolphins have their own signature whistle that is specific to them—sort of like a name!



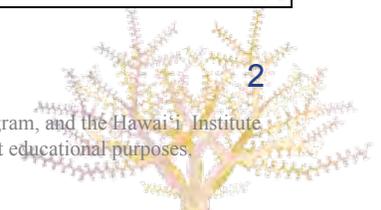
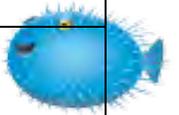
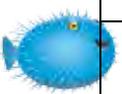
4. *Optional:* Go to the [NOAA Fisheries Sounds in the Ocean](http://www.fisheries.noaa.gov/national/science-data/sounds-ocean#humpback-whale) page and listen to sample dolphin (or other toothed whale) sounds. Discuss what you hear with your classmates.  
(<http://www.fisheries.noaa.gov/national/science-data/sounds-ocean#humpback-whale>)
5. In teams of two, choose one person to be the 'dolphin' and the other to be the 'echo.'  
*Note: You will switch roles, and each student will get to be both the dolphin and the echo.*
  - a. The role of the **dolphin** will be to locate, while blindfolded, the center of the target (to capture the fish) using echolocation.
  - b. The role of the **echo** will be to respond to the sounds of the dolphin to help guide them to capture the fish.
6. Come up with your own signature sound or whistle that is unique to you as the dolphin. Write it out here: This will be unique to each student. It may help to suggest that students clap or make other easy-to-generate sounds, like saying the word "click," rather than making a whistle sound (which can get tedious).
7. As a pair, come up with the different echo sounds that signal directions (left, right, forward, backward, and on target) to help find your target fish. Fill in the table below to help you remember.

*Some helpful tips:*

- You will have to remember what direction your sounds represent, so choosing sounds that are similar to the direction will make it easier. For example, left could be "lah" and right could be "rah."
- Each sound indicates one inch movement. For example, one "lah" from the echo tells the dolphin to move their arm one inch to the left.
- Sit side-by-side so you can give directions from the same perspective.

This will be unique to each student pair. Examples are below.

Sound Direction	Sound Description
<b>Left</b>	Lah for a short movement to the left.
<b>Right</b>	Rah for a short movement to the right.
<b>Forward</b>	For for a short movement forward.
<b>Backward</b>	Bok for a short movement backward.
<b>On Target!</b>	Ding Ding Ding! The dolphin stops!



8. Practice making and listening to your sounds.
9. Clear a space on your desk to represent an area of the ocean.
10. Your role as the **echo**:
  - a. When the dolphin is blindfolded, place their target somewhere on the desk (your ocean area) within arm's reach.  
*Note: For a harder challenge, fold or cut the paper to reveal only the target fish.*
  - b. Tell them to extend their arm above the worksheet and hand them the uncapped marker with the tip pointing down.
  - c. Let the dolphin know you are ready and listen for their call.
  - d. When they make their call, respond with the appropriate echo (refer to your table) that directs them closer to the center of the target fish.
  - e. Continue for up to one minute or until they are above the target.
  - f. When the dolphin is above the target (or after one minute), indicate that they should lower their arm and remove the blindfold.
  - g. Repeat the whole process for at least three trials. Be sure to move the target before the next trial!



11. Your role as the **dolphin**:

- a. Read the instructions b-h before you put on the blindfold.
- b. Extend your arm directly in front of you and hold the marker that the echo hands you.
- c. Make your signature sound and wait for the echo's response.
- d. Move your arm in the direction indicated by the echo's call.
- e. Repeat for up to one minute (or until you reach the target).
- f. When the echo indicates that you have reached the target (or after one minute), lower your arm so the marker tip touches the paper.
- g. Remove your blindfold and measure how close you were to the center of the target and record the distance and your observations in your table below.
- h. Repeat this process for at least three trials. Number each trial position with your marker.
- i. Now that you know what to do, put on your blindfold and follow steps i-v above. No peeking!



12. Switch roles and repeat! Answers will vary. We have provided examples of possible answers and ideas of what to look for in students' thinking.

Trial	Distance to Target	Observations
Trial #1	6 inches.	My pen went past the target fish because the echo made too many lah sounds!
Trial #2	Got it! Zero inches!	I found the target fish with my pen! When the echo made the ding sound, my pen was right on it!
Trial #3	2 inches.	For this trial, the target fish was farther away. The echo said I did great, but my arm was too short!



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## Activity Questions

1. What well for you:

a. as the echo (giving information)?

It is satisfying to see the my directions followed, and the dolphin getting closer to the target fish.

b. as the dolphin (receiving information)?

Being able to hear the echo made having on the blindfold feel calming. The echo helped me to be able to see!

2. What were some challenges you faced:

a. as the echo (giving information): It is challenging to make the echos always in the direction the dolphin is facing. Sometimes it is hard to wait for the dolphin to make the call before making the echo. And, it is hard to remember to just make echo sounds rather than just telling them where to go.

b. as the dolphin (receiving information)

It can be hard to remember to make the call to get the echo started. And, it was sometimes hard to remember what the echo sounds meant (like lah for left) or to remember which direction was right and which was left.

3. In order to locate the target when you were the dolphin:

a. What senses did you use to receive information?

The sense of hearing was useful to listen to the sounds of the echo. When I was the dolphin, I also used my sense of touch to feel if the pen touched the paper as I stuck it down.

b. How did you process the information you received from the echo?

(*Hint: what happened in your mind?*) When I was the dolphin, I had to hear the sound of the echo and think about what direction the sound meant. It felt sort of like translating from another language. I also had to think about which direction was left and which was right (or forward/backward) before I moved my arm. When the echo was quiet, I had to think STOP.

c. How did you respond to the information from the echo?

After thinking about what the sound meant, and which direction to turn, I tried to move my arm a small amount for each sound the echo made. When the echo made the ding - ding- ding sound, I stopped!

4. How is this activity similar to the ways that dolphins use echolocation in real life?

Dolphins use echolocation to locate objects, which is like what we did. And, just like us, dolphins send out a sound signal and receive an echo back. They process the information from the echo in their brain and then respond to the information they receive by swimming their body in response—just like I moved my arm in response to the echo!

5. How might dolphins use sound in other ways?

Dolphins also use sound to "talk" and communicate. I have heard dolphins making sounds on TV and at aquariums when their heads are above water. I imagine they also make sounds to each other underwater. Maybe dolphins even have their own name sounds!

6. How do you think that communication between dolphins is different than between humans?

I have seen dolphins touch each other and make noises at each other or even swim at each other in ways that look like they are trying to communicate. But, dolphins cannot read or write or make hand signals, so those ways of communicating are not available to them. I wonder if dolphins do types of communication we don't know about?

7. What are some challenges that scientists face when studying dolphin echolocation

and communication? Since echolocation is a sense that humans do not have, we can only imagine what the sense might feel like. And, since we cannot stay underwater as long, or swim as fast, or hear the dolphins' echoes, we have to use computers (and underwater hydrophones and speakers) and sensors or cameras to try to record the dolphin's sounds or behaviors and then interpret the data as best as they can.