"In Other Words...." or How Do Dolphins Sense Their Environment?

Student Activity Sheet

Name ______ Date _____ Class _____

Observations are any information that we gather using our five senses of sight, sound, touch, taste and smell. Human beings gather approximately 90% of all the information about their environment by using their sense of sight. How do dolphins gather information about their environment?

Materials:

6 information index cards Blindfolds Pencil Data sheet **Discovery of Sound in the Sea** web site - Animals and Sound in the Sea (http://omp.gso.uri.edu/dosits/animals/intro.htm)

Procedures for Activity 1:

<u> Trial 1</u>

- 1. You will work in a group of three.
- 2. Your group will be given three index cards.
- 3. Select one index card. On your card is a specific emotion or piece of information. Do not show your card to the other two members of your group.
- 4. For approximately 1 to 2 minutes, plan a way to communicate your information to your group members. You must produce a sound or sounds to communicate your information. You may vocalize and use your body to produce sounds but you may not use words.
- 5. You will have approximately 1 minute to communicate your information to the other two members of your group.
- 6. As the other two members of your group communicate their information to you, you are to fill in the attached data table under Trial 1.
- 7. Check your observations with the actual information being communicated by each group member.

<u>Trial 2</u>

- 1. Repeat steps 1,2 and 3. You will be given 3 new index cards.
- 2. You will have approximately 1 minute to communicate your information to the other two members of your group. They will each wear a blindfold this time.
- 3. After each member of your group communicates their information to you, you are to fill in the attached data table under Trial 2.
- 4. Check your observations with the actual information being communicated by each group member.
- 5. Using your data table and the *Discovery of Sound in the Sea* web site -Animals and Sound in the Sea section, answer discussion questions 1 and 2 for activity 1 in complete sentences.

Procedures for Activity 2:

- 1. One member of the group is to put on the blindfold.
- 2. One other member of the group is to drop their pencil on the table. The student wearing the blindfold is to point in the direction where the pencil was dropped.
- 3. The third member of the group is to record on the data table for Activity 2 whether the blindfolded member pointed in the correct direction. Put a "Y" for yes and an "N" for no.
- 4. Repeat 3 more times, dropping the pencil in a different location each time.
- 5. Repeat steps 1 4 for the other two members of the group. By the end of this activity, each student should have been the pencil dropper, the recorder and blindfolded.
- 6. Using your data table and the *Discovery of Sound in the Sea* web site Animals and Sound in the Sea section, answer discussion questions 1, 2 and 3 for activity 2 in complete sentences.

DATA TABLES

Activity 1

Name	Information Being Communicated			
	Trial 1 (without blindfold)	Trial 2 (with blindfold)		

Activity 2

Name	Pencil Location				
	Trial 1 (Y/N)	Trial 2 (Y/N)	Trial 3(Y/N)	Trial 4(Y/N)	

Discussion Questions for Activity 1:

1. During which trial, 1 or 2, was it harder for you to figure out the information being communicated to you? Why do you think it was harder this time?

2. What kind of information do you think dolphins would want to communicate to each other? What are some of the ways that they would be able to do this?

Discussion Questions for Activity 2:

1. How many times out of 4 did you correctly locate the dropped pencil? What do you think is the explanation for these results?

2. You are a hungry dolphin. Describe how you would find some tasty fish for your lunch.

3. If you were blindfolded and put into an empty room, how could you use vocal or non-vocal sounds to tell you how close you were to one of the walls?

"In Other Words...." or How Do Dolphins Sense Their Environment?

Teacher Strategy Section

Grade Level: Middle School (Grades 6-8)

Time Required: 45 minutes

Standards Addressed:

The Rhode Island Science Framework

- The Nature of Technology Technology and Science, Grades 6-8 (Benchmark 2 of 3)
- The Living Environment Diversity of Life, Grades 6-8 (Benchmark 2 of 5)

Middle School Performance Standards

• S2(c) Life Science Concepts

National Science Education Standards

- Teaching Standards A, B, C, D, and E
- Content Standards A, C, and G (Grades 5-8)

Objectives:

- 1. Students will demonstrate that humans rely on their sense of sight for most of their observations/communication.
- 2. Students will demonstrate that dolphins rely on their sense of sound for their observations/communication.
- 3. Students will describe information communicated by dolphins and explain how this information is transmitted.
- 4. Students will achieve with extension activities how a dolphin uses echolocation to find food.
- 5. Students will achieve with extension activities how to use echolocation to find their location in a room.

Background Information:

Dolphins and porpoises are the smallest toothed whales. Including orcas and pilot whales, there are 32 species of oceanic dolphins, 5 species of river dolphins, and 6 species of porpoises. Bottlenose dolphins, like Flipper the TV star, are the most familiar. While humans rely primarily on sight to perceive their environment, scientists all agree that dolphins communicate with one another by using sounds and body language.

Dolphins pass air through air sacs in their heads to produce sound. The nasal system of a dolphin is made up of a number of nasal air sacs and plugs that open and close when air is moved from one sac to another. The sound is then channeled through fats in their forehead (called the melon) and into the water in front of the animal. Recent advances in bio-acoustic research indicate that a tissue complex in the dolphin's nasal region is likely the site of all sound production.

Clicks and whistles are the two main types of dolphin vocalization. Each individual dolphin has its own "signature whistle", which is a series of whistles, like a dolphin Morse code, which is distinct from any other member of the group. This signature whistle provides a way for dolphins to recognize and bond with others.

Some dolphins use echolocation to help them find and capture food. Using mechanisms in its melon, the dolphin makes clicking sounds. When these sound waves echo back from an object, the dolphin may be able to identify the object as well as tell its size, direction, shape, speed, distance and composition. Echolocation can be used on objects 5 cm (2 inches) or smaller up to 100m (325 feet) away. In other words, some dolphins can use echolocation to detect a golf ball size target almost the length of a football field away!

Dolphins produce non-verbal sounds by slapping a body part against the surface of the water, which makes both a sound and a splash. Tail or fluke slapping is also common. Kerplunks are another non-vocal sound made by the tail. Other parts of the body used to produce noise in a slapping manner are pectoral fins and the whole body. Finally, jaw claps are made either above or underwater.

INSTRUCTIONAL STRATEGIES

A. Preparation:

- Prepare 6 index cards for each group. Write a different emotion on each of the six index cards. Examples include happy, sad, angry, afraid, love, hunger and thirst. (Hint: laminate the cards for added durability.)
- 2. Make two blindfolds for each group using an old sheet or towel.
- 3. Review **Discovery of Sound in the Sea** web site Animals and Sound in the Sea (<u>http://omp.gso.uri.edu/dosits/animals/intro.htm</u>)

B. Assessing Prior Knowledge:

Begin the class with a group discussion. Ask the students the following questions:

- 1. What are some of the ways that humans communicate with one another?
- 2. Which of the five senses do humans use the most to gather information about their environment?
- 3. What kind(s) of information do humans communicate?

- 4. What are some of the ways that dolphins communicate with one another?
- 5. Which of the five senses do dolphins use the most to gather information about their environment?
- 6. What kind(s) of information do dolphins communicate?

Tell the class that they are going to do an activity in which they will use verbal and nonverbal methods to communicate information to the other members of their group. Distribute the student activity sheet and data table and explain/demonstrate the directions to the class.

C. Procedural Tips:

Activity 1

• The teacher can use a variety of emotions and situations on the index cards - they should be a challenge for the students to communicate.

Activity 2

- Vary the objects that are used for example, try using lollipop sticks instead of pencils.
- Vary the times that the objects are dropped. For example, the teacher could have all the pencil droppers in each group drop their pencils at the same time for one of the trials.
- Play a radio or music or introduce some other source of background noise during the activity, or introduce background noise for some but not for all of the groups.
- Tell the students to indicate not only the direction where the object is dropped but also to estimate the distance away from them that it is dropped.
- If you are able, conduct the experiment in a larger area where students will be able to drop the object on the floor around the blindfolded student, including in back of the student, as opposed to being dropped only on a table top.

Answers to Discussion Questions for Activity 1:

- 1. Trial 2 was harder due to the fact that the student was not able to use his/her sense of sight to gather the information.
- 4. Dolphins would want to communicate information related to feeding, aggression, reproduction, defense and identification. Dolphins communicate vocally and non-vocally. Vocal sounds are produced in the nasal system. The sound is sent through fats in the melon and into the water in front of the animal. Non-vocal sounds are made by slapping a body part against the surface of the water, such as in tail or fluke slapping, kerplunks, lunges and breaches. Jaw claps are made above or underwater.

Answers to Discussion Questions for Activity 2:

- 1. Answers will vary. The student had to depend only on his/her sense of hearing to locate the pencil. This would have made locating the pencil more difficult.
- 2. A hungry dolphin uses echolocation to find a fish. Using mechanisms in the melon, a dolphin makes clicking sounds. When the sound waves echo back from the object, the dolphin is able to identify the object as well as tell its size, direction, shape, speed, distance and composition.
- 5. Answers will vary. The student can clap his/her hands together and listen to differences in sound as he/she approaches a wall. The student can do the same thing by making a noise and listen to differences in the sound as he/she approaches the wall.

Assessment:

- Each student responds to discussion questions.
- Each student collects data and records it in data tables.
- Have students write a paragraph comparing and contrasting dolphin communication to human communication.

Extensions:

Grades K-5

The students can play a variation of the following game. Increase the difficulty depending on the grade level. The game is called "Echolocation".

- One student is the dolphin and wears a blindfold. The other students are either obstacles or fish. The obstacles will make one sound; fish will make another sound. Determine the sounds before you begin to play.
- The dolphin will try to find a fish while avoiding the obstacles. Once the student who is the dolphin is blindfolded, tell the students who are playing the obstacles to sit, stand or lie down and not move. The students who are playing the fish will slowly move around the obstacles.
- The dolphin is to make a high-pitched sound every time it wants to know what is in its path. Any student in the dolphin's path must respond with the appropriate sound, depending on if he/she is an obstacle or a fish. The dolphin must move toward the fish and touch it. The tagged fish becomes the next dolphin. The obstacles and fish switch. This allows all of the students to play various roles.

For younger students, during story time, the teacher can also read the book "Dolphin's First Day - The Story of a Bottlenose Dolphin".

Grades 9-12

- Students can study the anatomy and physiology of the dolphin in detail as it relates to sound production and then compare and contrast it to the anatomy and physiology of humans as it relates to sound production.
- Students can study how scientists have used echoes to map the ocean floor. Give the students a table showing a series of times it took a sound to make a trip to the ocean floor and back at several locations and then have them calculate the depth of the ocean at those points using the formula:

D = speed of sound x 1/2 time

Using the information students can create a graph or topographical map of this region of the ocean floor.

Vocabulary:

Echolocation

A method of determining distance of objects or depth of the seafloor by measuring the time it takes for reflected sound waves (echoes) to return to the sound source. Some whales and dolphins use echolocation to identify underwater objects and to help find food.

Fluke

The dolphin's tail fin, it spreads out from side to side. When the dolphin swims, it pushes the tail fluke up and down to help him dive or leap out of the water.

Kerplunk

A technique used by dolphins to drive fish away from protected areas such as sea grass beds. A dolphin will lift its tail and lower body out of the water and crash it down on the water surface. This causes a loud splash and creates a trail of bubbles under the water. The bubbles startle the fish hiding in the seagrass and flush them from their hiding places, making it easier for the dolphin to detect them.

Melon

The melon is the rounded region of a dolphin's forehead that helps to focus sound.

Pectoral Fins

Pectoral fins are the dolphin's flippers.

Resources/References:

Books with Activities for Teachers

Kaner, E. 1991. Sound Science. Addison-Wesley Publishing Company, Massachusetts. 96 pages.

Siepek,K.L. 1994. Step-by-Step Science Series - Sound. Carson-Dellosa Publishing Company, Inc., Greensboro, North Carolina. 48 pages.

Printed Resources

Au, Whitlow, W.L. 1993. The Sonar of Dolphins. Springer-Verlag New York, Inc., New York, New York. 277 pages.

Rowland, D. 1991. Explorer Books: Whales and Dolphins. Parachute Press, New York, New York. 53 pages.

Zoehfeld, K.W. 1994. Smithsonian Oceanic Collection - Dolphins First Day - The Story of a Bottlenose Dolphin. Trudy Management Corporation, Norwalk, Connecticut and the Smithsonian Institution, Washington, D.C. 31 pages.

Web Sites

Discovery of Sound in the Sea http://omp.gso.uri.edu/dosits/dosits.htm July 29, 2002

Bridge-Ocean Sciences Teacher Resource Center <u>http://www.vims.edu/bridge/</u> July 30, 2002

Echolocation Mechanism in Dolphins http://www.unb.ca/courses/biol4775/SPAGES/SPAGE9.HTM July 30, 2002

Marine Mammal Vocalizations: Language or Behavior

http://www.umassd.edu/Public/People/KAmaral/Thesis/marinemammalacoustics. html July 30, 2002

Oceanlink http://oceanlink.island.net July 30, 2002

Rainbow Dolphin http://www.rainbowdolphin.com/index.htm July 30, 2002

Sea World

http://www.seaworld.org/index.asp July 30, 2002

This activity was developed by Rhode Island school teacher Janet Alden during the *Discovery of Sound in the Sea* Teacher Institute. University of Rhode Island, Office of Marine Programs, 2002.