Fishy Communication

Adapted from: Activity 39 "Partners in the Deep" Living in Water. The National Aquarium in Baltimore, 1997.

Grade Level: Basic

Duration: 1 class period

Setting: classroom

Summary: Students will examine the sense of sound and how fish use specialized organs to detect each other in dark water.

Objectives: Students will become familiar with sound sensory organs in fish and how they work.

Vocabulary: light refraction, binocular vision, monocular vision, otoliths, lateral line.

Related Module Resources:
- Fact Sheet *Smart Angler's Notebook Fish Senses: Taste and Smell*
- Fact Sheet *Smart Angler's Notebook Fish Senses: Sight*

Materials (Included in Module):
- Small containers with varying contents
- *Smart Angler's Notebook Fish Senses: Hearing and Sound.*

Additional Materials (NOT Included in Module):

ACADEMIC STANDARDS: ENVIRONMENT & ECOLOGY

7th Grade
4.6A Explain the flows of energy and matter from organism to organism within an ecosystem
- Describe and explain the adaptations of plants and animals to their environment

10th Grade
4.7B Explain how structure, function, and behavior of plants and animals affect their ability to survive
- Describe an organism's adaptations for its survival in its habitat.

12th Grade
4.6A Analyze the interdependence of an ecosystem
- Analyze the relationship among components of an ecosystem

BACKGROUND: Fish have fine tuned senses. A fish's sight, hearing, smell and taste are achieved through specialized body parts. Fish have internal ears, one inner ear on each side of their brain. The inner ear receives and interprets sound and helps the fish maintain balance. They also have **otoliths**, solid ear bones, which are surrounded by a fluid filled sac that is lined with tiny hairs. The sound waves penetrate the fish's body and vibrate the otoliths, this stimulates the hairs and attached nerves. Next, a signal is sent to the brain. The air bladder can also function as a resonating chamber that intensifies sounds.

Another body part that aids in hearing is the **lateral line**. The lateral line is a row of tiny pores, which are openings to tubes, running from the head to their tail along the sides of the fish (PA Fish & Boat Commission, 2000). The tubes go through the scales to a large nerve. The fish receives sound waves or low frequency vibrations along the length of its lateral line. Fish can tell with great accuracy the location of the noise or disturbance. The lateral line also helps schooling fish keep together.

A fish does not have eyelids, tearducts, or irises like humans do. Instead, they have lenses in their eyes that move back and forth much like a camera lens (PA Fish

& Boat Commission, 2000). Since fish live in the water they must adapt to a property of light called refraction. **Light refraction** occurs when light travels from air into the denser water, it bends. So, to a trout, a mayfly at the surface appears higher than it actually is. Binocular vision helps to judge distances, but monocular vision is better because fish are near sighted and can see things close to them better than far away images. Fish have **binocular** (using two eyes) and **monocular** vision (using only one eye). They can see in almost all directions except for small blind spots directly in front of and behind them. Fish can also see in three dimensions. Fish also have cones and rods in their eyes, which enable them to detect colors and ultraviolet light as well as seeing movement and contrast. Walleyes have a reflective layer in their eyes that helps them to reflect available light in dark or cloudy water (PA Fish & Boat Commission, 2000).

OVERVIEW: Students will experiment with hearing sound and using other senses to understand how fish locate each other.

PROCEDURE:

Teacher Preparation:

*Refer to the *Smart Angler's Notebook Fish Senses: Hearing and Sound* located in the binder under **Fact Sheets**. Make one copy for each student.

1. Ask the students to write a paragraph describing what it would be like in deep water. Remind them to use their senses (sight, smell, taste, hearing, and touch). Ask them to think of ways that fish find each other in the deep, dark water.
2. Ask the students to volunteer reading their paragraphs and record some of their ideas on the board.
3. Pass out one container to each student. (The containers have already been filled for you) You may choose to darken the room but it is not necessary for the activity. Tell the students they cannot talk or make any other sounds with their voices. Instruct the students to walk around the room shaking their container to locate their same species.
4. When all the students are sure they have found their mates, have them sit in groups. Then, one group at a time, remove the lids and see if they were accurate.
5. Record how many were right and wrong in each group.
6. Have the students return to their seats and collect the film cans.
7. Refer to the **Discussion** section.
8. Hand out the *Smart Angler's Notebook Fish Senses: Hearing and Sound* fact sheets. You may choose to have the students read it together or individually.
9. Refer to the **Evaluation** section.

Student Activity:

1. Write a paragraph describing what it would be like in deep water. Address all of your senses (sight, smell, taste, hearing, and touch).
2. You may choose to read your paragraph aloud to the class.
3. Your teacher will give you a container. You are to walk around the room shaking your container and find other students (same species) in the class making the same sound you are. You may not talk or make any other vocalizations.
4. When you think you have found all of your species, sit in a group.

Suggestions:

-No talking
-Gill flares (flapping hands by cheeks) means no match-get lost!
-Undulating body means I understand you-lets stick together!
-Individuals of the same species lock arms to indicate that are in a school and less vulnerable to predation
-Have a predator in the second round who, after 1 min., can tap a lone fish and make them sit down

DISCUSSION:

Ask the students if they used any strategies to locate each other. For example, did they repeat a specific rhythm? Did they use the call and wait for a response method?
Ask the students what some of the problems were. *Too many sounds at once or some cans may sound very similar.*

What could happen if a predator was listening? What would happen if a ski boat traveled overhead? *A predator would be able to locate them and possibly eat them. A boat engine would cause more noise making it difficult to hear your partners.*

Talk about the benefits of schooling behavior to avoid predation (safety in numbers, looking larger, flash scattering behavior)

Ask the students to discuss how this model was like the real thing and how it was different. Could they design a more realistic model? *Maybe, if your school has a swimming pool!*

Refer to #8 of the **Teacher Preparation**.

EVALUATION:

- After the class has read the *Smart Angler's Notebook Fish Senses: Hearing and Sound* fact sheet, review the vocabulary terms and answer student's questions.
- Describe the sensory organs of a fish. Compare and contrast them with the sensory organs of a human.
- List the functions of the sensory organs in relation to the distance of the noise. Which organs sense relatively close noises and noises that are further away?
- Collect data using the time until everyone has grouped up, number of mistakes in grouping, or number of lone fish eaten by predator. See how data improves with successive trails by the whole class.

EXTENSIONS AND MODIFICATIONS:

- Set it up so 80% have one sound and 10% of two other sounds (how fast do they group in this situation?)
- presence/absence of predator

- Add cotton/kim-wipe to each container to stimulate muted communication due to pollutant (like a pesticide)
- Students draw from a pollutant lottery that specifies how often/and what freq. They can shake their canister
- Combine with turbidity glasses where students try to recognize conspecifics on basis of either sight (colored badge) and/or sound
- Borrow two snare drums from the music department. Place the drums on opposite sides of the room. Ask one volunteer to hit one of the drums while the other students place their hand on top of the other drum. One drum will send vibrations and the other drum will receive them. The swim bladder is similar in function; it sends and receives sound.
- Assign research papers on the different ways fish and other mammals communicate with each other. Bioluminescence, sound, chemical attractants, and electrical currents are among some of the ways animals communicate.

NOTES (PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE):