

CAVITATION, ANYONE?

(When you're a shrimp, you're a shrimp all the way)

Name _____ Date _____ Class _____

INTRODUCTION AND BACKGROUND INFORMATION FOR STUDENTS:

Student Inquiry Questions

In these activities you will be investigating how marine animals use non-vocal sounds. The activities you will complete are designed to stimulate you to think about the following questions:

- How do marine animals use non-vocal sounds?
- For what purposes do marine animals use non-vocal sounds?
- How do these uses compare and contrast to how humans use non-vocal sounds?
- With regard to their uses of non-vocal sounds for communication, are human cultural and sub-cultural groups analogous in any way to groups found in the marine animal communities?

Background

Marine animals use vocal and non-vocal sounds to communicate a variety of signals. These include sounds made to signal a desire to mate, to communicate the appearance of danger (predators), to navigate, to find food, and to fight or defend territory. This activity concerns itself only with those sounds which are classified as 'non-vocal', or sounds not made by vocalizations of marine animals. Such sounds include the more familiar ones, such as the hard smack of the tail of the gigantic whales, and more unusual ones, like the secondary source of sound that comes from the collapse of high-speed bubbles created by tiny shrimp! This is an example of cavitation.

Cavitation is the formation of gas-filled bubbles in liquids in motion when the pressure is reduced to a value less than the vapor pressure of water while the surrounding temperature remains constant.

Non-vocal sounds are defined as sounds made without the use of vocal folds or other body parts whose primary function is moving air for sound production. In animals these sounds are typically made by slapping a body part on the water or land surface, or by forcefully clapping body parts together. Non-vocal sounds may be used to communicate acoustically. Vocal sounds are sounds made with the use of vocal folds or other body parts whose primary function is moving air for sound production.

Process for Student Activities

First, you will listen to a presentation made by your teacher. This presentation will explore some human uses of non-vocal sounds. While, or after you listen, you will identify the sound, the culture and context, and explain what it communicates on Activity Sheet #1a. On Activity Sheet #1b, you will list some examples of vocal sounds humans use. You will specify what these vocal sounds communicate, and what purposes they can be used for. You will share your answers with your classmates, and discuss any areas of interest that arise.

Next, you will complete a web site navigation segment that samples a number of 'non-vocal' sounds that are made by marine animals. While, or after, you listen, you will identify the sound, describe it, and state the purpose for which you think it is used on Activity Sheet #2a. You will compare these with some of the vocal sounds made by marine animals on Activity Sheet #2b.

The last part of this lesson will focus on your skills as a writer. Once again, you will be given an Activity Sheet with Tables to fill out, as you listen to selected files or sound recordings chosen by your teacher. After you listen carefully to the sound, specifying as much detail in the quality of the sound as you can, you will revise your description, writing in the most vibrant and elegant form you can. This description should be in complete sentences. You will then write a final descriptive statement of 2-3 sentences which brings to life the quality of the sound and specifies how and for what purpose the sound is used.

Finally, you will take the results of your inquiry and help create a group project that clearly demonstrates your answers to the student-inquiry questions and general conclusions you have made about the various uses of non-vocal sound.

NECESSARY MATERIALS:

1. At least one Computer w/ Internet access in the classroom.
2. Three activity sheets for each student: seven pages total.
3. Musical recordings of Mr. Bojangles, Riverdance, and Flamenco Dancing.
4. Tape Recorder and /or CD player

Activity #1:

Goal: To investigate how and why humans use non-vocal sounds, and compare your observations to what you have discovered or concluded about marine animals use of non-vocal sounds.

Discussion Questions for Activity #1

1. What generalizations can you make about these human non-vocal sounds?
2. Compare these to sounds (marine) the animals you listed in your brainstorming activity make. Do you notice any difference?

Activity # 2:

Goal: By using Student Activity sheet #2a, you will practice web site navigation in order to learn about the sounds the different marine animals produce and begin to speculate about the common ways in which marine animals use non-vocal sound. You will compare the use of non-vocal and vocal sounds by filling in the chart #2b.

Discussion Questions for Activity #2

1. What are some of the ways marine animals use non-vocal sounds?
2. How would you distinguish between vocal and non-vocal sounds marine animals produce?
3. How would you group these sounds according to their purpose?

Activity #3:

Goals: To represent the unique quality of individual non-vocal sounds, using vivid and effective language in well-crafted grammatically correct sentences. To make further conclusions about animals' use of non-vocal sound.

Complete the process writing assignment, as indicated on Activity Sheet #3.

Discussion Questions for Activity #3

1. Have your understanding and formulation of information about how marine animals use non-vocal sound changed since the beginning of activity #1?
2. What choices did you make when revising and editing your sentences?

Procedure for Post-Activity Assessment: Working with a group, you will create a project [chart, game, innovative combination thereof, or experiment] that compares and contrasts humans' and marine animals' uses of non-vocal sounds. This project design should be arrived at by group consensus. It should demonstrate answers to the student inquiry questions. When it is complete, present your project to the class.

Suggestions: A game, a synthesized chart that blends information from both tables and draws some interesting conclusions, a skit, a PowerPoint presentation. (Many of these formats can also incorporate sound files.)

TEACHER STRATEGY

Grade Level: Middle School

Time Requirement: There is some room for variation, depending on how long the discussion sections run, but generally:

Activity # 1: (15-20 minutes); Activity # 2 (20-30 minutes), and Activity #3 (15-30 minutes) Student project: two to three class periods

Activity #1 and Activity #2 can easily be completed in a single 55-minute period. It is also possible for Activity #3 to begin within the same single period, and finished for homework.

Suggested time for Activities: 1-2 classes of 55 minutes each.

Suggested time for total unit: 3-5 classes of 55 minutes each.

Standards Addressed: (from Performance Standards New Standards 1997)

Science Standards

Scientific Thinking Standard 5c: *The student uses evidence from reliable sources to develop, descriptions, explanations, and model; and makes appropriate adjustments based on additional data or logical arguments.*

Scientific Thinking Standard 5f: *Works individually and in teams to collect and share information and ideas.*

Scientific Tools and Technologies Standard 6d: *Acquires information from multiple sources, such as print, the Internet, computer data bases, and experimentation.*

Scientific Communication Standard 7a: *Represents data and results in multiple ways, such as numbers, tables, and graphs; drawings, diagrams, and artwork; technical and creative writing; and selects the most effective way to convey the scientific information.*

English Language Arts Standards:

Conventions, Grammar and Usage of the English Language E4

Objectives:

1. To discriminate between non-vocal and vocal sounds in marine animals.
2. To explore the uses of non-vocal sounds by marine animals, and develop a clear idea of the basic purposes for use of non-vocal sounds.
3. To compare the uses of non-vocal sounds for communication in marine animals, with the uses and varieties of non-vocal sound in human cultures and subcultures.
4. To master sentence structure, and improve vocabulary, while writing about science.

Background Information:

This unit teaches students about marine animals' use of non-vocal sound, while reinforcing the elements of good sentence structure and effective word usage through a process writing activity. In order to understand how marine animals use non-vocal sounds, the students will compare and contrast what they find with some samples of how humans use non-vocal sounds.

A secondary emphasis is discriminating between some of the aesthetic functions in the samples provided in Activity #1, and the more practical uses evidenced by the marine animals. If you are working with a more sophisticated group, you may want to include a direction—in activities #1, and especially #3—to include a metaphor or simile in their description of the sound. If so, it would be good to point out that poetry, which concerns itself intrinsically with rhythm, depends upon the sound of words as well as their meaning. You may have already noticed that the title of this activity “Cavitation, Anyone?” is an intentional phonic reference to the popular PBS series on poets, “Anyone for Tennyson?”

Activity #1 really stresses the use of non-vocal sound in complex human activities, like dance. The intention of including references to poetry and dance is to allow for discussions of what make humans' use of sound distinct from that of marine animals, namely an aesthetic purpose. Nonetheless, even such uses should be seen as on the higher end of a continuum, as the main point of the activity is to afford students' the discovery of how similar the communicative purposes of non-vocal sound in human and marine animals kingdoms really are.

You will want to view relevant portions of the Discovery of Sound in the Sea Web site, before proceeding with the Activity, so that you clearly understand the uses of non-vocal sound by marine animals. Especially important locations on the site will be listed in Section A: Preparation.

Procedure

1. Hand out Activity Sheet for Activity #1. Students will listen to Teacher's recitation of Teacher Script, including CD or taped recordings and downloaded sound files from Web site. Students will fill in table #1a, and then share answers and discuss any areas of interest that arise. Student will fill in chart #1b.
2. Hand out Activity Sheet for Activity #2. Students will use Web site links in specified order, and fill in chart 2b. Locate sounds for chart #2b in the Audio Gallery.
3. Hand out Activity Sheets for Activity #3. After being given activity sheets, student will listen to sounds from computer files, or tape recordings the teacher or students have made. The emphasis in this portion is on WRITING PROFICIENCY. Students complete revisions, and edit revisions. Students share results.

Instructional Strategies:

Activity # 1: Teacher moderates & directs topics as they "unfold". For example, if a student talks about how Irish stepdancing conserves '*Irish culture*' here, but was originally probably used as a ritual mating/courtship activity in 18th and 19th century Ireland, she (or he) can point out that one of the uses of non-vocal sound in both animal and human kingdoms is for mating rituals.

The first sound file, is a recording of poetry, that is punctuated by finger snapping. You can explain that this was commonplace during the 'beatnik' era, and, more recently, as part of the spoken word 'poetry slam' tradition. Or, you can simply discuss the use of finger snapping as a way of establishing the beat, or rhythm, that all poems have.

You will want to explain that tap-dance, that originated with slavery, was the African American's solution to percussion. Without traditional tribal drums, that would have been prohibited, they developed a beat by dancing on wooden boards. (soft-shoe tap dance)

If students are not aware, explain what castanets are, and that Flamenco dance is associated with Spain, but is from the gypsy tradition.

You can save any or all of the above information for the discussion question section. If you are working with a group that draws a complete blank, it may be acceptable to give students a few clues, but not outright answers as you proceed through the files and recordings. The main point is to get students hypothesizing about which groups are using the non-vocal sounds in which contexts. Even partial or "wrong" answers will accomplish this.

Students will then provide some examples of human vocal sounds, and fill in chart #1b with a list of what they communicate.

Activity #2: You will want to choose the most proficient student(s) to navigate the Web-based segment if only one computer is available, so that the class can move quickly through activity #2. It may actually be preferable to demonstrate with use of a single computer, even if you have more available, so as to keep your class "on the same page." It is a good idea to have a strong reader read the feature creature on Snapping Shrimp aloud, so that students develop the most clear idea of what cavitation is.

After students have read about other ways marine animals communicate, they will fill in the chart of vocal and non-vocal sounds, using the specified sound files.

Activity #3: You will need to decide how you are going to collect additional files for marine animals' non-vocal sounds. You should use one example from each of the categories of marine animals: invertebrates, fish and marine mammals. We recommend Spiny Lobster, the Garibaldi Fish, and the Dolphin on the Discovery of Sound in the Sea web site. However, if you find clearer, or more evocative sounds

elsewhere, use them, as a primary purpose of the activity is representing sound vividly and articulately.

If you plan to do Activities 1-3 in a single day, it would be advisable to have selected these sound files from within the Discovery of Sound in the Sea web site.

You should use your own style of cueing revision and editing segments of writing process and encourage students' artistic expression as they write their rough drafts and revisions of sounds.

Preparation

1. Produce for each student: Activity Sheets #1, #2, and #3: seven pages total.
2. Read Teacher Script to yourself for practice.
3. Create 3 sound files or recordings of: "Mr. Bojangles", Irish step dancing, and Flamenco dancing.
4. Procure dictionaries and several thesauri for activity #3.
5. Supply your standard revision and editing checklists for activity #3.

Assessing Prior Knowledge

1. Ask students to list different ways people use sound to communicate
2. Ask students to write about the ways they think marine animals use sound to communicate.

Procedural Tips

1. Recordings of Mr. Bojangles can be found at the following site and by typing mr bojangles in to google: www.geocities.com/poofcat/bojangles.html, (video and instrumental only).
2. Most recordings of Mr. Bojangles do not have soft-shoe tap sounds in background. B.J. Thomas' recording does have percussion notating the click of bojangles' heels, and Neil Diamond's recording has background beat that emulates the sound of taps. For this reason, you may actually want to visit: www.tapdance.org/tap/sounds/images/gregstan.mov, and play the short clip, after you've shown the geocities audio-visual clip.
3. If you or someone you know is interested in tap, use CD's or cassettes available. An excellent one that has a version of Mr. Bojangles on it is Jazz Tap by The American Tap Dance Orchestra, recorded in the Leon Collins Studio.
4. Good soundclips of Irish stepdancing were surprisingly difficult to locate. I would try using an audiocassette or CD of a Riverdance performance. If these are not readily available, go to www.riverdance.com. There are soundclips there, although the stepping is not highly audible on the recordings. Also, try typing Irish Internet Hub in your search engine. This is a collection of sites and has many for Irish Music. As a last resort, return to www.tapdance.org/tap/sounds. There is an audio clip of step-dancing to fiddle music, although it is not really Irish step-dancing.

5. You can get good sound clips of Flamenco dance music at www.flamenco-world.com/scripts/ficha/ficha.php?id=735 . These have audible castanet percussion in the background. Listen to several and find the clearest example.
6. If you or one of your students has castanets, you can simply play them along with a sound clip of Flamenco.

Answers to Discussion Questions for Activity #1

1. Generalizations are that the sounds aid in the appreciation of music or dance. They keep the beat or rhythm.
2. They require technology—like shoes, or castanets. They're made intentionally, not automatically.

Answers to Discussion Questions for Activity #2

1. Marine Animals make non-vocal sound both directly—like the whales, and indirectly—like the snapping shrimp. In the case of the shrimp, it's really the collapsing bubble that makes the sound, but it still has the purpose of stunning prey to aid in food gathering.
2. Some sounds are not clearly 'vocal' or 'non-vocal', like the humming of the Midshipman Fish, used for mating. Also, the sound made by Mormyrids comes from a detached air bladder. It really is a non-vocal sound.
3. Marine animals use both vocal and non-vocal sounds for courtship (mating), territoriality (defending), food gathering (feeding), aggression, and communicating with their young.

Answers to Discussion Questions for Activity #3

1. Students may note that they understand some of the similar purposes for sounds in humans and marine animals.
2. Students will share their word and punctuation choices, and discuss criteria for making them. Ex. "I used a long sentence followed by a short sentence for effect. I wanted to express surprise or shock."

Post Activity Assessment

Assign students to groups or have them choose their own. Students will design and produce a project that clearly informs an audience about the uses of non-vocal sound in the marine animal kingdom, and how it compares with the use of sound in the human world. The project can be a play, a chart, creative writing, a Powerpoint presentation, a game or any other kind of performance. If you want to provide a grade for the unit, or merely evaluate how thorough the understanding of the students is, you could provide a rubric for scoring. A suggested rubric is:

1. How effectively does the project show the 5 purposes for which marine animals use sound?

2. How well does it demonstrate some of the unique uses of non-vocal sounds by marine animals?
3. How thoroughly are comparisons and contrasts made between human's and marine animal's uses of sound developed and presented?
4. How effectively do students generalize about their findings?
5. How accurate are their hypotheses, if they make any?
6. Overall originality and creativity of project?
7. Clarity and Coherence of project/performance?

EXTENSIONS for SECONDARY and POST-SECONDARY LEVELS:

Use information recorded in Activity #3 to create poetry that uses both vocal and non-vocal sounds. Show what the purpose of the non-vocal sound is, and how it increases the value of the poem.

Descriptive portions should be a departure point for longer meditative writing. You can use free association exercises with groups or individuals, or write to music, as students write longer pieces.

- *Creative Writing Extension:* Use meditative writing(s) as inspiration for crafting a short story or poem.
- *Research Writing Extension:* After writing a short descriptive vignette of one of the sounds, follow it with a 1 page research paper on the animal that makes the sound and how the sound is used.
- *Web Page Extension:* Create a web page on the same material as research writing extension, and link to recordings on Discovery of Sound in the Sea web site.

Vocabulary

Cavitation

The formation of gas-filled bubbles in liquids in motion when the pressure is reduced to a value less than the vapor pressure of water while the surrounding temperature remains constant.

Swim bladder

A bladder found in some fish that fills with air and aids in flotation.

Non-vocal sound

Sounds made without the use of vocal folds or other body parts whose primary function is moving air for sound production. These sounds are typically made by slapping a body part on the water or land surface, or by forcefully clapping body parts together. Non-vocal sounds may be used to communicate acoustically.

Vocal sound

A sound made with the use of vocal folds or other body parts whose primary function is moving air for sound production.

This Activity was developed by Rhode Island teacher Nancy Craven during the Discovery of Sound in the Sea Teacher Institute. University of Rhode Island, Office of Marine Programs, 2002

Teacher Script
(Teacher NARRATED Portions in Italics)

Just as different cultures and subcultures have unique ways of producing sound with their bodies—

- Play Sound File A) "Spoken Word" recitation of poem 'Our Daily Bread'

or their shoes

- Play recording of segment of Mr. Bojangles w/ soft shoe tap-dance in background
- Then play Sound File B)--- Irish Step Dance Music

or their shoes and simple instruments

- Play recording of the castanets and foot sounds in Flamenco Dance

So do animals use audio body language in less artful, practical ways that are, thanks to Mother Nature, effective, and sometimes of equal rhythmic beauty to what dancers, jazz lovers and poets produce.

I will now play the previous series of sounds for you one by one. As I play each sound, write in the provided spaces on Activity Sheet #2--Table of Human Non-vocal sounds, the appropriate specified information.

As you play each file, make sure you do not give answers to students, but assure them that any guess is better than nothing if they seem frustrated or truly stumped. This may well happen with some groups of middle school students, especially when filling in the purposes or culture and context sections. Later, when you discuss answers, you can use partial answers or guesses to lead into more informative or 'correct' answers. Student Activity Sheet for Activity #2a