



NATIVE ANIMALS IN AN AHUPUA'A

Concepts

Echolocation

HCPS III Benchmarks

SC. 1.4.1

SC. 1.1.2

Duration

1 hour

Source Material

Bat Conservation
International
PRISM

Vocabulary

Echolocation

'Ōpe'ape'a (Part II: games on echolocation)

Summary

Students will play games to simulate echolocation in Hawaiian hoary bats. After the games, students will discuss what they learned as a class.

Objectives

- Students will participate in games and work as a group.
- Students will be able to explain how Hawaiian Hoary bats use echo to find preys.

Materials

Blindfolds (bat and moth masks – see supplemental materials)

Blackboard/whiteboard or chart paper

Making Connections

While humans and bats are similar in many ways (both are mammals, have hairs, warm blooded, give birth to live young...), we have different life habits. Bats are nocturnal and navigate by sound and echolocation. Since we rely heavily on our sight, it is hard for us to imagine how bats navigate in the dark. Blindfolding the students will force them to rely more on their hearing, hence relating more to the bats.

Teacher Prep for Activity

- Reserving playground/gym or arranging classroom for the activities.
- Obtain blindfolds, or construct masks using templates provided in Supplemental Materials. Print them out and make copies with construction paper. Adjust the size of the mask with the copier if need to. Help the students color the masks and drill holes on the side for strings or rubber bands.

Background

The game idea and simulation activity are modified to demonstrate how the Hawaiian Hoary Bat uses echolocation and how some of the moth species it preys on have adapted to counter the detection. Here is the specific information in BATS magazine Vol.13, No.4, that the idea came from:

“In Hawaii, certain moths have adapted to take advantage of the Hoary bats' longer-range social calls. By adjusting their hearing downward, the moths can detect bats from farther away, allowing them to take earlier evasive action. Biologist James Fullard



discovered that Hawaii's noctuid moths (the most common family of moth) have developed special hearing sensitivity at 9.8 kHz, and no longer hear much higher than the bat's 27.9 kHz echolocation frequency. These moths can afford such a low-frequency specialization only because there are no other bat species to avoid in Hawaii. (Most other North American bats rely heavily on higher echolocation signals, often in the 40-45 kHz range.) Many moths that hear an approaching bat try to escape by dropping to the ground or by flying into foliage. Hawaiian hoary bats are fast, tenacious hunters that sometimes pursue moths to within six inches of the ground, making longer-distance hearing quite advantageous (<http://www.batcon.org/index.php/education/article-and-information/bats-magazine.html?task=viewArticle&magArticleID=730>, last retrieved May 2009).”

Procedure

Begin the lesson with the sound clips of Hawaiian hoary bats (see Supplemental Materials). The sound clips serve as examples for students to mimic the calls of Hawaiian hoary bats during the games. If the students are having trouble mimicking Hawaiian hoary bats, they can clap to make noise instead.

Bat hearing simulation

This game is a classroom simulation and can be played as an introduction to the Bat vs. Moths game. All that is needed are blindfolds (see bat mask attached) and objects to make noise with, or students can simply clap, whistle, hum, etc. Also, there is an option to record the results of the simulation—a blackboard, a whiteboard, or some chart paper will be needed.

1. For this simulation, pick one (or a few) students to be humans trying to hear and locate where a sound is coming from without using their sense of sight. They sit, blindfolded, in chairs around the room. The rest of the students—one at a time--make sounds (ring a bell, clap a hand, whistle, etc.)
2. The students in chairs point to the direction in which they hear the sound coming from. The teacher should mark down how many times the bats are accurate in their guesses.
3. Now, have the students in the chairs become “bats” and use “bat ears” to try the experiment. They turn their ears into “bat ears” by cupping their hands around their ears to see if it helps them to hear and guess more accurately. Record the results of this variation in a separate column.

Questions to answer: was it easier to guess accurately with “bat ears?” Why? (The larger ears help it to receive more sound waves and thus hear better.)

Bats vs. Moths game

This game should be played after the introductory exploration which includes work with the concept of echolocation. Conduct the game in a large open space. Require 4-6 blindfolds total (see masks in supplemental materials).

1. Use the entire class. Find a large open space either indoors or outdoors. Have most of the students form a large circle to be the “trees” in the forest that the Hawaiian Hoary Bat prefers as a habitat.
2. Designate 4-6 students to be “moths” and 1 student to be the “bat.” The bat and the moths are blindfolded with their own bat or moth masks.



3. The objective of the game is for the “bat” to catch the “moths.” All children should be instructed that this is a **slow walking game** and reminded how to tag safely!
4. On the signal, the bat and moths will walk in any direction for 15 seconds. The trees stay still but must say “tree” to warn the bat and moths when they come close. The bat and moths stop on teacher’s signal
5. The bat walks around making bat squeaks and trying to tag the moths. The trees and moths stay still but must respond to the bat’s call. The trees say “tree” and the “moths” say a SOFTER squeak to simulate being the echo the bat is using to find them!
6. Once a “moth” is tagged, he/she is “eaten” and goes to join the “trees.”
7. Allow 2 minutes for each bat to catch his/her preys. Rotate the roles after each turn. (Note: try making the game easier for the “bat” by giving him/her more “moths” to eat, or harder by giving him/her fewer “moths” to eat.)
8. Now a twist to the game to demonstrate the native moth’s adaptation: continue to play the game with the same rules. But after echoing a squeak, the moths can squat down to avoid being tagged by the bat.
9. Ask the “hiding” moths to stand back up after counting to 10. Rotate the roles every 2 minutes.
10. After playing the games, conduct a discussion session with the class on how bats catch their preys. Have the students write a few sentences or draw a picture of bat hunting.

Assessments

- Participation in games.
- Participation in discussion session.

Resources

See ‘Ōpe’ape’a (Part I: virtual tour).

Extension Activity

Another game activity modeled after Bats vs. Moths to demonstrate how bats in crowded conditions find their babies as compared to the Hawaiian mother bat using sound to find her babies

The Hawaiian bat finds her babies by listening for their distinctive sounds, which works fine since they live in a solitary style. For bats that live in colonies, however, this would not be as efficient since there would be so many sounds to sort through. Using smell works better.

Materials: blindfolds, old cologne (be aware of any allergy problems) or baby powder

1. This game is played in almost the same way as the Bats vs. Moths game. However, the object would be for the blindfolded mother bat to find her babies, and the students in the middle are either baby bats belonging to the mother, or just other bats in the colony.
2. To identify the babies, rub a bit of baby powder on their hands and arms. Have half the children in the middle be babies, and the other half are just other adults.
3. Also, since the simulation is a cave, instead of trees, the circle should be smaller. The children on the outside are silent observers since the mother bat is using smell rather than sound to find her babies.



4. The babies and non-babies can move around, but in a very controlled, mincing walk as space is tight!
5. When Mother bat successfully tags her babies, they should leave the circle and go to the bat nursery (perhaps identified by a jump rope circle or hula hoop.)
6. Variations:
 - a. Have two mothers and two sets of babies. Identify by using two different scents.
 - b. Turn the “cave” into a “forest” by having the students on the outside form a bigger circle. As before, half the students on the inside are Mother Bat’s babies, but half are not. The babies identify themselves with a squeak that is different from that of the bats who are not the babies. Mother Bat tries to find her babies by sound in this variation, rather than by smell.
(Note: make it harder by having two moms, two sets of babies (making different sounds, and maybe a few non-baby bats!)
7. Make a chart of the results of this game comparing whether it was easier for the Mother Bats to find their babies by sound or smell, and whether having two sets of babies to choose from made it more difficult.

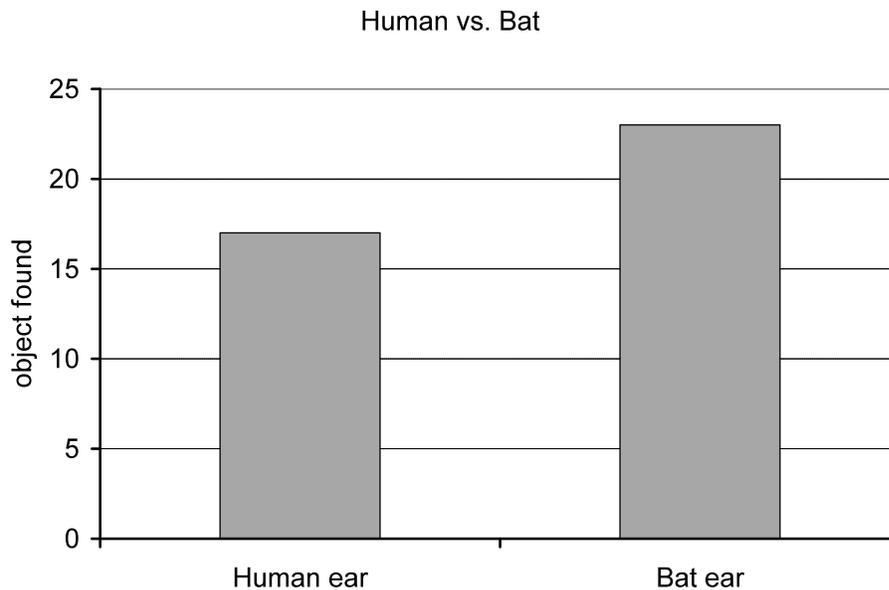


Math Connections

Students tally the results (with help of the teacher) from Bat Hearing Stimulation game on a chart paper. Have each student summarize the results into a column or bar chart.

Example:

	Human ear	Bat ear
	3	5
	3	5
	4	4
	3	5
	4	4
total	17	23



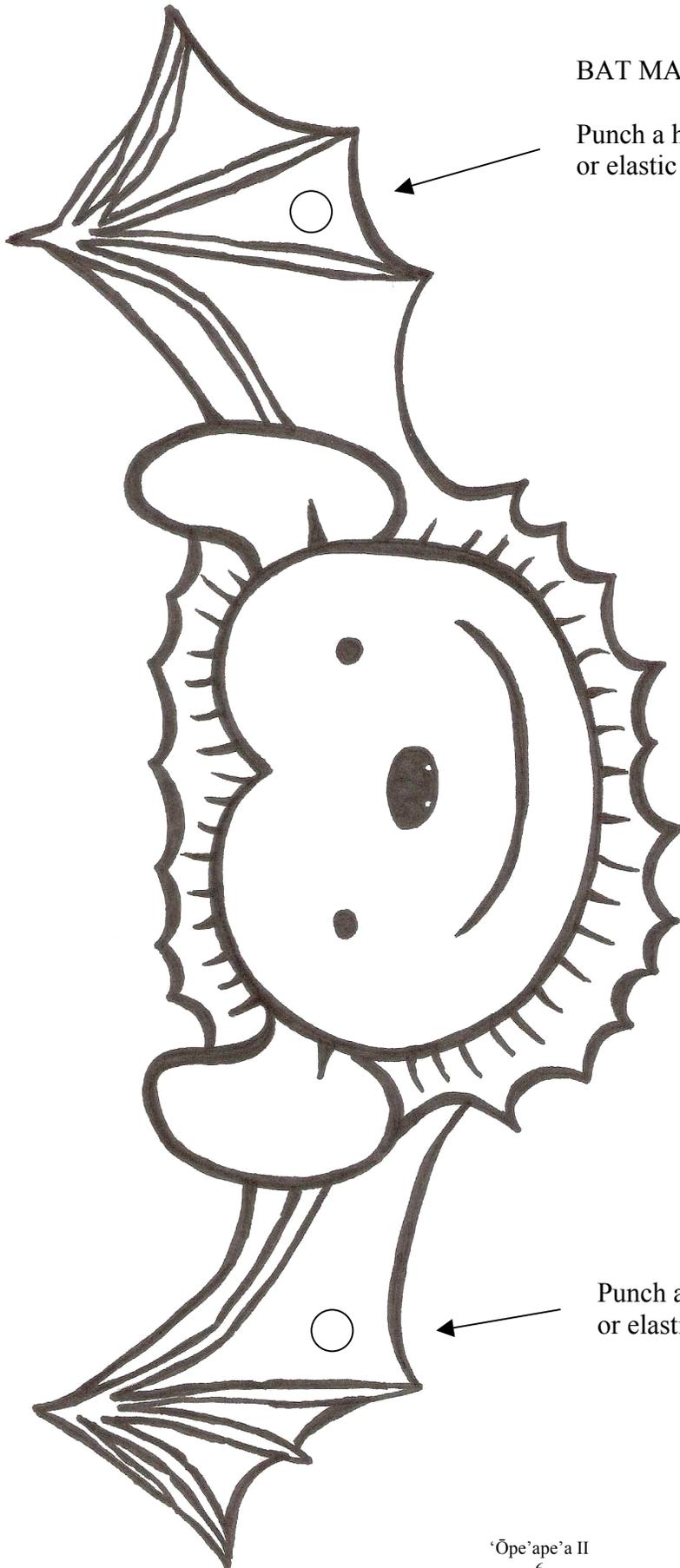
Supplemental Materials

- 1) The sound clips of Hawaiian hoary bats (Opeapea1 and Opeapea2) in WAV format are enclosed with the electronic file of this lesson.
- 2) The templates in the following 2 pages are provided for mask making.



BAT MASK

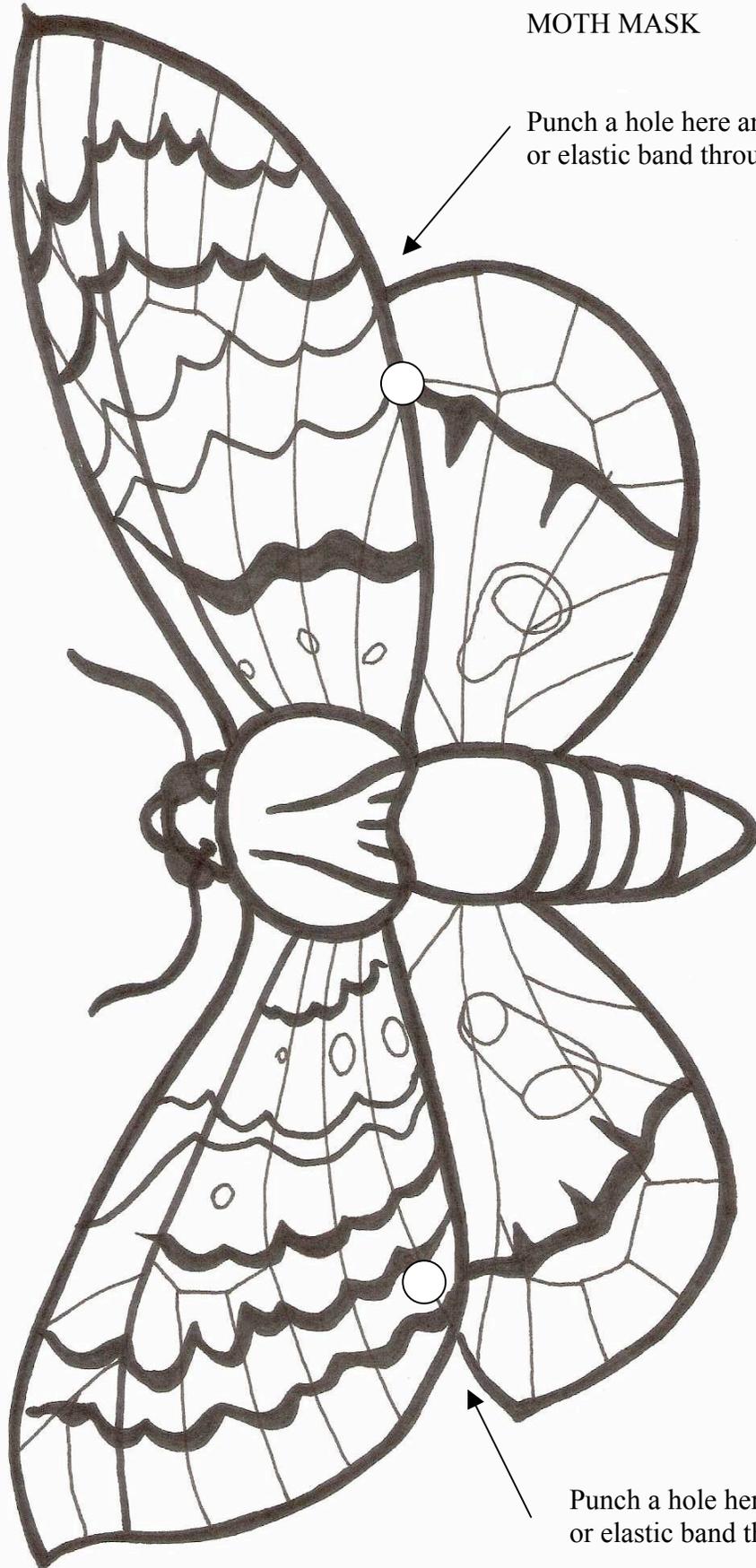
Punch a hole here and feed a string or elastic band through



Punch a hole here and feed a string or elastic band through



MOTH MASK



Punch a hole here and feed a string or elastic band through

Punch a hole here and feed a string or elastic band through