



Echo, Echo, Echolocation!

EXPLORATION QUESTIONS

What are insectivores and why are they important? What kind of physical adaptations do bats have that make them able to successfully hunt at night?

MATERIALS

- blindfolds
- bat wings and mask (optional)

OVERVIEW

Students will simulate a natural predator/prey relationship in a game of tag and learn about the concept of echolocation.

VOCABULARY

Insectivore, echolocation, predator, prey, tragus

GROUP SIZE

5-140

AGE

5-13

Background

Almost all bats in North America are insectivores – they feed on insects. Bats are our most important predators of night-flying insects consuming mosquitoes, moths, beetles, crickets, leafhoppers, chinch bugs, and much more! Many of these insects are serious agricultural or forests pests, and others spread disease to humans or livestock. Every year bats save farmers **billions of dollars** in pest control simply by eating insects.

Scientists have discovered that some small bats can catch up to 1,000 or more small insects in a single hour. A little brown bat can eat as many as 3,000 mosquito-sized insects in a single night. But, a nursing mother bat eats the most – sometimes catching more than 4,000 insects in a night!

Despite the saying “blind as a bat,” bats can see quite well. Many species can see as well as humans can. Yet, eyesight doesn’t help much when flying through the forest at night. Instead, bats have developed a remarkable method of using sound to enable them to navigate and find food in the dark called echolocation.

Using echolocation, bats emit very high-pitched, ultrasonic squeaks through their mouths or noses that bounce off obstacles in their path. Bats make these calls as they fly around, and they listen for the returning echoes. Hearing the echo, bats can identify how big an object is, whether it is moving or staying in place, and the

distance to the object. If an object appears large, bats steer away; if an object is small and in motion bats dive quickly to catch the insect prey. Bat echolocation is so sophisticated that these animals can detect an object the width of a human hair. Not all bats echolocate. In fact, about 70% of all bat species worldwide have this ability.

Special Ears

The ears of insect-eating bats are specially adapted to gather sound waves. The ears are large with a broad, scoop-like form that sticks out well above the head to allow better hearing. Bats also have a special structure in their ear called a tragus. This small, sword-shaped piece of skin is located in front of the ear canal (humans have one too!). The tragus plays an important role in directing sounds into the ear that help with prey location and navigation. Because the tragus tends to be obvious in bats, it can also be an important feature that scientist use to differentiate between species of bats.

Nighttime Sounds

Bats are constantly emitting sounds while in flight. Fortunately, most bat echolocation occurs beyond the range of human hearing. Bats can be generally characterized by their echolocation calls as either shouting bats or whispering bats. Big brown bats and little brown bats are shouters and produce sounds (if we could hear them) of 110 decibels which is similar to the loudness of a smoke alarm. Northern long-eared bats are whispering bats and produce sounds of 60 decibels which is similar to the levels of normal human conversation. Shouting bats tend to forage for food in open spaces. Whispering bats grab insects from the leaves of trees and forage in the cluttered environments of forests. Bats do make some sounds that humans

can hear such as the squeaks and squawks they make in their daytime roosts. These noises aren't considered to be echolocation sounds.

Get Ready – Background Activities

Explain to students that bats are not blind, but that eyesight may not be the most important sense they use to find food. Ask what other senses might be important to bats. Ask if anyone knows how an insect-eating bat finds its food. After discussion, give a basic explanation of how echolocation works. If you have access to the internet, we recommend you play the short video, [Echolocation](#) by Batney Ears. It is only 1.14 minutes long.

Get Set – Set Up Simulation

1. Ask the students to form a large circle. This circle will represent the area in which a bat will be looking for food.
2. Ask for a volunteer to be the hungry insect-eating bat. Have that student come into the center of the circle.
3. Ask if anyone knows what kinds of insects are the prey for this predator. As students make suggestions (mosquito, gnat, moth, beetles, and crickets) have them also come into the center of the circle until you have three to five types of prey. (Lightning bugs are usually not bat food because they are poisonous. Moths are a favorite!)
4. Explain that when the game starts, the bat will be blindfolded not because it cannot see, but because its hearing will be most important. The bat will send out its echolocation sounds by saying "Bat!" often. Tell the insects that this represents the bat's echolocation signal being sent out to see if anything is near. Although the insects may move around, they must return the signal each time by returning their echo, saying loudly what they are (example: "Mosquito!" or "Gnat!"). The bat must hear their echoes to try to catch them. Instruct the forest circle to remain quiet to allow the bat to concentrate on its echolocation skills. Have students hold hands to maintain their positions and provide a protected area in which the bat and insects must remain. If the bat gets close to the circle, they should say, "tree."
5. After being blindfolded, the bat can start saying "Bat!" If you have bat wings or a bat mask, you can

let the student wear them – just for fun. Remind the bat that it is hungry, and should constantly use its echolocation. And, remind the insects that they must respond. The bat must "tag" the insect to "capture" it. The captured prey immediately become part of the forest circle. Play several rounds to allow all students the chance to experience either the predator or prey position.

Note: With a mixed age group or a very aggressive bat, the insects might not stand a chance. A student acting as a building or lamp post can be added in the middle of the circle and respond "Building" or "Lamp post" to each bat signal sent out. This stationary object will provide a little protection for the flying insects.

You may also introduce background interference by adding constant shuffling of feet of the students in the circle. It will add confusion and promote concentration by the bats to differentiate the sound of the prey from the surrounding environment.

For very young students, it will be easier to have all the students inside the circle be one type of prey such as a moth. This will help the young bat find its prey.

Extension Activities

1. For younger students: Discuss where they think a bat would live and what animals need in a habitat. Using this website discuss cave habitats and what it would be like for a bat to use echolocation in a cave.
2. For older students: Share with the students that moths are a common food for many bats, and that some moths have evolved interesting tactics to survive bat attacks. Some species have fuzzy wings that reflect bat echolocation pulses. Other moths in the families Noctuidae and Arctiidae have "ears" which can sense bat echolocation. These "ears" are membranes stretched over sensors located on the head, body, or wings of the moth. Once a bat is detected, these moths may fly in loops, make noises to startle the bat, or fold up their wings and dive to avoid capture. Ask the students to suggest methods that bats could develop to counter these evasive maneuvers. Answers could include producing sounds that detect fuzzy wings, using frequencies beyond the

range of insect hearing, confusing insects by flying erratically, or other ideas that they generate.

Reflect – Student Evaluation

Discuss with the students:

Who is the predator and who is the prey in this activity?

Describe how echolocation works.

What special adaptations does an insect-eating bat have that helps it find food?

Further Reading and Resources – Discover More

About Bats

Bats Eat Bugs – And Other Good Things -

https://drive.google.com/file/d/0B_iOF_14IONBb3YtZnlqUjJQNEk/view

Bats and Echolocation

What is Echolocation - <https://www.youtube.com/watch?v=K-zrBalt-38>

Curriculum Connections

Common Core State Standards

English Language Arts Standards » Speaking & Listening » Grade 5

Comprehension and Collaboration:

[CCSS.ELA-Literacy.SL.5.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.

[CCSS.ELA-Literacy.SL.5.1.a](#) Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.

[CCSS.ELA-Literacy.SL.5.1.b](#) Follow agreed-upon rules for discussions and carry out assigned roles.

[CCSS.ELA-Literacy.SL.5.1.c](#) Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

[CCSS.ELA-Literacy.SL.5.1.d](#) Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

[CCSS.ELA-Literacy.SL.5.2](#) Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.