

ECHOLOCATION

OBJECTIVE:

The students will take part in a simulation of bats using echolocation.

NGSS: MS-LS1-4 (Animals), MS-LS1-8

NGSS CONNECTION: MS-PS4-2

**MATERIALS:**

- Blindfolds, eye masks, or safety goggles filled in with soft cloth/felt (one for each student)
- Optional: String or rope to create boundaries in the room



TIME: 1 hour

Teacher preparation

- Gather materials
- Prepare an area with enough space for students to move around safely.

Teacher background

Almost all bats in North America are insectivores – they feed on insects. Bats are our most important predators of night-flying insects consuming moths, beetles, mosquitoes, crickets, leafhoppers, chinch bugs, and many more.

Despite the saying “blind as a bat,” bats can see quite well, but eyesight doesn’t help much when flying through the forest at night. Bats use echolocation to navigate in the dark. Using echolocation, bats emit very high-pitched, ultrasonic squeaks (too high for humans to hear) 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. After 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. Some bats can even discriminate the texture of an object! Not all bats echolocate, but about 85% of all bat species worldwide have this ability.

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. Most 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. The tragus plays an important role in directing sounds into the ear that help with prey location and navigation.

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 louder 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.

Engage

1. Begin by asking students what echolocation is and how bats use it to navigate and locate objects in the dark. The students can learn more about echolocation with the video below. <https://www.youtube.com/watch?v=K-zrBalt-38>
Stop at the 3-minute mark.
2. Remind students that a common misconception is that bats are blind and that as a class, they have already learned that bats are not blind, but that eyesight may not be the most important sense they use to find food.
3. Ask students what other senses or body parts that they have already learned about might be important to bats as they hunt for food.
4. Explain that in this activity, students will simulate how bats use echolocation to find objects in a dark room.

Explore

1. Ask the students to form a large circle. This circle will represent the area in which a bat will be looking for food. Set up the room by turning off the lights or darkening the room as much as possible.
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 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.
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 nearby. 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!”
6. 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.

TO MAKE THE GAME MORE CHALLENGING: Have two or three blind-folded people (BATS) make three different sounds one at a time.

Evaluate

After the activity, discuss their experiences and observations. Ask questions like:

1. How did you try to locate the object in the dark?
2. Did you notice any patterns in the sound pulses?
3. How is this activity similar to how bats use echolocation?
4. Who is the predator and who is the prey in this activity?

5. How echolocation works?
6. How is sound energy being transferred?
7. What special adaptations does an insect-eating bat have that helps it find food?

NGSS Connections

Have students identify the type of wave used in echolocation and describe how the energy is transferred.

ELPS

Go over the instructions for the game to make sure students understand the rules and the purpose of the activity.