Bats

Many bats have the ability to detect the size, shape, texture and speed of objects using echolocation. **Echolocation** occurs when the bat emits a sound, which travels away from the bat, bounces off objects and returns to the bat. The bat can detect changes in the returning sound waves or echoes. From these changes, the bat can characterize objects (such as insects) in its surroundings. In this activity, students will simulate bats and insects and the life process of echolocation.

Background on Bats and Echolocation

Almost all bats in North America are insectivores (insect eaters). A single Little Brown Bat can eat as many as 3,000 mosquito-sized insects in a single night. Bats are often seen at dusk swooping around street lights and outdoor lamps. The light attracts night-flying insects, the bats' food source.

Despite the saying "blind as a bat" bats can see quite well. However, sight is not what makes them such skillful predators. Bats use their sense of hearing to navigate and find food in the dark. Using their voices and their ears, bats locate objects using echolocation.

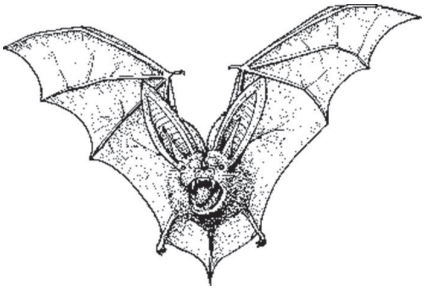
The ears of bats are specially adapted to gather sound waves. Their ears are large with a broad, scoop-like form and project well above their heads to allow better hearing. While flying, bats continuously emit high-pitched, ultrasonic squeaks through their mouths or noses. These sounds are inaudible to humans. The emitted sounds radiate out until they hit an object and bounce back to the bats as an echo. Hearing the echo, bats can judge the distance, location and size of objects in their paths. If an object appears large, bats steer away; if the object is small and in motion, the bat dives quickly to catch the insect prey.

Scientists have used electronic recordings to study the sounds made by bats. From these studies, we know that many bats have unique call signatures, just like birds, so bats can be identified by their calls. We also know that bats can vary their calls, depending on the prey they are pursuing.

General Background on Bats

Bats are among the most misunderstood animals. Bats don't swoop down on people to try to get into their hair and they are not flying mice.

Bats are mammals. They have hair, and give birth to live young, like most other mammals. They do produce milk to feed their young, like all other mammals. And, like many other mammals (humans are a notable exception), bats are mainly active at night. However, unlike all other mammals, bats can fly. Other mammals, such as flying squirrels, may be able to glide, but only bats are capable of sustained flight. Because of this, scientists classify them as a separate group, or Order, called Chiroptera, which means "hand wing." Their wings are, literally, their hands: the bones of their greatly elongated fingers are connected by an expanded membrane, forming a wing.



Grade Levels: 3–10

Objectives

The students will investigate bats by participating in a role-play activity as a bat or insect to:

- *explain* the relationship that exists between insectivorous bats and their food source.
- *demonstrate* a simple form of echolocation.
- *recognize* that physical adaptations allow animals to respond to life needs.

Materials

For the bat:

- Blindfold

To wear:

- Appropriate seasonal clothing.

Credits

Adapted with permission from the Project Underground Bat Echoes activity in the Project Underground education guide.

When

All seasons, weather permitting.

Time Required

30-60 minutes

Where

All parks.

Resources

Bat Conservation International. 1991. *Educator's Activity Book About Bats.* 63 pp.

Linzey, D. W. 1998. *The Mammals of Virginia.*

McDonald and Woodward Publishing Company, Blacksburg, VA. 459 pp.

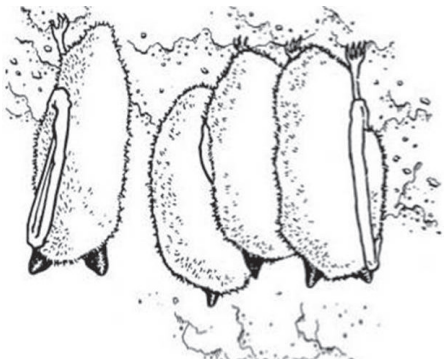
Macdonald, D. 1987. *The Encyclopedia of Mammals*. Facts on File xlvii.

Of the more than 1,240 species of bats alive today, about 30 percent eat fruit, nectar or flowers. Most of these fruit eating species do not use echolocation. The remaining 70 percent of the bat species all use echolocation as the primary method by which they perceive their surroundings while flying.

Bats that echolocate live everywhere except the polar regions and extreme deserts. They have extremely varied diets, ranging from nectar and pollen to insects, fish and blood.

The United States is home to 47 species of bats. Seventeen species have been documented in Virginia, although only 15 are likely to reside in the state. All of the bats in Virginia echolocate and feed on insects.

The bats in Virginia are divided into two categories: cave bats and tree bats. Cave bats hibernate in caves, while tree bats hibernate in leaf clusters, under decaying logs, in hollow trees, or sometimes in abandoned mines or old buildings. Virginia has eight species of cave bats and seven species of tree bats.



Bats

The limestone caves west of the Blue Ridge provide ideal conditions for hibernation. Many species of bats also use caves as safe places to give birth and rear their young.

During hibernation, a bat relies on stored body fat for the energy necessary to stay alive until spring. If it is awakened early, a bat will use up some of its stored fat. If the bat stays awake long enough, or if there are several awakenings, this disturbance (whether intentional or not) can cause the bat to use up all its stored fat and cause the bat to die. This is one reason some caves are posted with "No Trespassing" signs or fitted with gates to keep people out.

White-nose Syndrome in Bats

White-nose syndrome is a disease affecting hibernating cave bats. It is named for the white fungus that appears on the muzzle and other body parts of hibernating bats. First documented in New York in the winter of 2006-2007, WNS spread rapidly across 23 states in the northeastern, mid-Atlantic and midwestern United States and five provinces in eastern Canada. By 2014 this devastating disease had killed millions of cave bats, possibly even bringing some species to the brink of extinction.

Bats with WNS exhibit uncharacteristic behavior during cold winter months, including frequent awakenings, flying outside in the day and clustering near the entrances of their hibernation areas. Although it appears bats shed the fungus during the summer months, weakened female bats may have a harder time reproducing, resulting in lower birth rates among survivors in years following a WNS infection.

Numerous laboratories and state and federal biologists are investigating the cause of the bat deaths. A newly discovered fungus, *Pseudogymnoascus destructans* (originally called *Geomyces destructans*), causes WNS. Scientists are investigating the dynamics of the fungal infection and transmission, and searching for a way to control it, as well as developing strategies to help surviving bat populations recover.

White-Nose Syndrome in Virginia Bats

Bats with WNS has been found in all of Virginia's cave and karst counties with seven of the eight species of cave bats in Virginia being affected to varying degrees. The Virginia big-eared bat is the only cave bat species in Virginia not documented with WNS, but the big-eared bat is very rare and only occurs in a handful of caves. By 2014 the vast majority of Virginia's cave bats had died, with the most common species exhibiting death rates of more than 90 percent. The prognosis for the remaining cave bats in Virginia is uncertain at best.

Procedure for Echolocation Activity

Before the Trip:

1. Review the information about bats and echolocation.
2. Discuss some of the information on bats from the background section.

At the Park:

1. Explain to students that bats are not blind, but that eyesight may not be the most important sense they use to find food. Ask if anyone knows how an insect-eating bat finds its food. After discussion, give a basic explanation of how echolocation works.
2. Ask the students to form a large circle. This circle will represent the area in which a bat will be looking for food.
3. Ask for a volunteer to be the hungry insect-eating bat. Have that student come into the center of the circle.

4. Ask if anyone knows what kinds of insects are the prey for this predator. As students make suggestions (mosquito, gnat, moth, some kinds of beetles and some kinds of 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.)
5. 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 sonar by saying "Bat!" often. Tell the insects that this represents the bat's sonar signal hitting them 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 environment 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.
6. After being blindfolded, the bat can start saying "Bat!" Remind the bat that it is hungry and the insects that they must respond. The bat must tag the insect to "capture" it. The captured prey becomes part of the environment 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 tree or lamp post can be added in the middle of the circle and respond "Tree" or "Lamp post" to each bat signal sent. This stationary object will provide a little natural protection for the flying insects.

Follow-up to Echolocation activity

After playing the game for several rounds (teacher's discretion), ask the students to discuss the game. Some questions to ask might include:

- Who is the predator and who is the prey in this activity?
- What special adaption does an insect-eating bat have that helps it find food?
- How would increasing the number of mosquitoes affect the bat? Decreasing?
- How would having the mosquitoes further away affect the bat? Closer?
- How is the game similar to how a bat uses echolocation? Different?

Follow-up to Bats

Students can do research on the bats, start by having them ask an inquiry question to answer.

- How many endangered species bats are in Virginia? United States?
- How has White-nose Syndrome affected bat populations, both through the years and across the United States?
- What cave bat species live in Virginia? What tree bat species live in Virginia?
- In what area of Virginia do the cave bats hibernate? Why?
- How has White-nose Syndrome affected endangered species of bats?
- How does biologist study bats?

Books

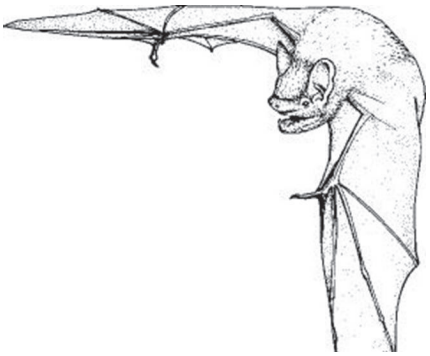
Prouty, Doug. Bats! *Why Should You Care?* Contra Costa County Office of Education. www.cccoe.k12.ca.us/bats/.

Terwilliger, K., ed. 1991. *Virginia's Endangered Species.* Proceedings of a symposium. McDonald and Woodward Publishing Co., Blacksburg, VA. 672 pp.

Tuttle, M. D. 1988. America's *NeighborhoodBats: Understanding and Learning to Live in Harmony with Them.* University of Texas Press, Austin. 96 pp.

Webster, W. D., J. F. Parnell, and W. C. Biggs, Jr. 1985. *Mammals of the Carolinas, Virginia, and Maryland.* University of North Carolina Press, Chapel Hill. 255 pp.

Zokaites, Carol. Ed. 2000. *Project Underground: A Natural Resource Education Guide. Second Edition.* Project Underground, Inc. 130 pp. www.karsteducation.org.



Standards of Learning: 3.4, 3.5, 3.6, 4.5, LS.8, LS10