Bats for Students and
Home Educators

Educational Resource Packet

Woodlands Nature Station
Land Between the Lakes
Golden Pond, KY 42211
Bat & Moth Game

Bats can find their food using sound waves called echolocation. Play this game to see if you can be a bat and catch a moth using sounds and hearing alone!

You will need:
- 4 or more friends
- Blindfold
- Large area to play in

How to play:
Decide who will be the bat and who will be the moth. Everyone else will be trees. All the trees make a circle around the bat and the moth. The object of the game is for the bat to catch the moth. Both the bat and the moth can move inside the circle of trees but can’t go outside it. Blindfold the bat, and spin the bat around three times.

The bat shouts “BAT,” and the moth has to immediately shout “MOTH,” back. As the bat moves in the direction of the sounds from the moth, the moth tries to escape. (It’s best if the bat and moth walk.) The bat can call “BAT” as many times as they want, and the moth must immediately answer, “MOTH.” If the bat or moth bumps into a tree, the tree shouts, “TREE.”

The game ends when the bat touches the moth. Then the moth can be the bat and one of the trees can be the moth. If there are a lot of players, try playing with more than one bat and moth.

Post-Game Questions:
1. How did it feel to be the moth?
2. How did it feel to be the bat?
3. How was the bat able to find the moth?
4. What is it called when a bat uses sound to find its food?
Build a Bat House

Why Build a Bat House?

You might be surprised: bats don't always live in caves. Some bats spend winter months in caves, but most bats spend summers in trees, under bridges or in old buildings, where they give birth and rear young.

Your goal is to make a bat house that mimics the space between bark and a tree trunk. That would be the bats' ideal nursery. That's why the space inside a bat house is very narrow, unlike a bird house which would house a nest. Bats like tight spaces. They also need it nice and warm for the babies. That's why we paint the box a dark color in most climates and why we caulk the sides to keep the heat in. Also, you'll be using a saw to rough up inside the box. That makes it more like tree bark and easier for the bats to climb up.

You might wonder why you need to build a bat house. Why can't the bats just find a nice tree? That is the challenge for many bat species as forests are cleared. Ideally they would live in a natural home but we build bat houses to help those who can't find space in a forest.

A bat house is also a great way to provide cover for wildlife, as well as a place for wildlife to raise young--two components of becoming a National Wildlife Federation Certified Wildlife Habitat site.
Why should I build a bat house?
Currently, bat populations in the United States are in a steep decline due to habitat loss and an invasive fungus called white nose syndrome, which disrupts hibernation. By putting up a bat house, you can help reverse this trend. Bats are much more effective than electric bug zappers at reducing insect pests. Bat houses provide a peaceful and effective solution for removing bats from attics and other spaces where they are unwelcome.

A Little Bit About Bats:
- There are about 1,240 different species of bats in the world.
- They are the only flying mammal and comprise about 20% of all known mammal species.
- Bats have good vision, but they use a navigational method called echolocation to locate obstacles and find flying insects. Echolocation is a series of high frequency sounds that bounce back to their ears.
- All eastern U.S. bats eat insects.
- Bats are a great "non-chemical" insect control!
- Bats eat large numbers of agricultural pests including: corn borers, grain and cut worm moths, potato beetles, and grasshoppers.
- Less than one-half of one percent of bats contract rabies. The bats that contract rabies are seldom aggressive.
- Attracting bats to your yard with bat houses will not increase the likelihood that they will move into your attic or wall spaces.
- Bats will not compete with birds for either food or space.
- The “economy” bat house design shown in this brochure can house 50 bats.
- The “post” bat house design shown in this brochure can house up to 200 bats.
Construction and Placement Tips:

Economy Bat House

- Use exterior grade (untreated) plywood or cedar. Keep any interior wood rough or cover it tightly with plastic screening (not metal) to give the bats something to grip.

- Make sure all seams are sealed with an exterior grade silicone caulking. This will help keep moisture out, as well as maintain the internal temperature. Paint or stain the exterior with a good exterior decked/siding finish.

- In northern regions, paint the exterior of the box dark brown. Place the box so it will receive at least four hours of sun each day. Both of these techniques will help keep the box warm.

- In extreme southern regions, painting the box exterior a light color or even white will help reduce the intense heat. Place the box where it gets less than four hours of sun each day.

- Place the box as high as possible. Records show that the higher the box is placed the more likely bats are to use it. One recommendation is to mount the box on a 4x4 treated post that is 16 feet long. The post should be set 2 1/2 - 3 feet in the ground.

- Placing two boxes back to back facing east/west has increased success rates.

- Placing boxes in small clearings or forest edges near a pond or stream is recommended.

- Attaching boxes to trees has been proven unsuccessful in most cases. Poles or buildings are much more productive locations.

Post Bat House

- The best wood to use for the 4x4 post is oak, red cedar, or black locust. You may consider joining two 8-foot posts together. This would allow you to place a treated timber in the ground and use the other recommended types for the upper part.

- The box itself can be made of a variety of wood since it is not in contact with the ground. If you use something other than cedar, we recommend that you use an exterior primer and finish coat of paint (tan or brown color) to extend its life.

- Do not use treated lumber for any parts bats may have contact with.

- Use only galvanized screws to put the bat box together.

- Spacing between the bat box and the 4x4 post is critical. Any more than 3/4 inch will make it more attractive to mud daubers and paper wasps.

- Place boxes in small openings especially along the edge habitats near ponds and along the edge of forest roads, utility rights-of-way, small forest gaps, or other similar open habitats.

- Locating boxes in clusters of three to five seems to provide a variety of options for a colony of bats. They can move from box to box reducing parasitism and predation, as well as find the optimum temperature based on weather conditions.

What if they’re living in my attic?

No need to fear! Bats will not damage the structure and can peacefully co-exist with humans. Bats sleep most of the day and leave the roost at dusk. However, if you prefer that bats live somewhere else, the best removal method to use is called exclusion. Identify entry/exit spaces and seal them. The best time for this is late fall or winter when bats have left for the season. In the summer, hang screening over the holes to allow bats to leave, but not re-enter. Be sure there are no bats (especially young) left inside before you seal the spaces.

For more bat information visit www.batconservation.org/.
Small Economy Bat House

Materials Needed (makes 1)

- 1/4 sheet (2' x 4') 1/8" cdx (outdoor grade) plywood
- 1 piece 1" x 2" (0.75" x 1.75" finished) x 8' pine (furring strip)
- 1/8" mesh HDPE (plastic) netting, 20" x 22.5"
- [such as Internet product #XV-1670 (1-800-328-8456)]
- 20-30 1 1/4" multipurpose (drywall) screws
- 1 pint latex acrylic paint
- 1 tube paintable acrylic caulk
- 5/16" staples

Recommended Tools

- Table saw or handsaw
- Variable speed reversing drill
- Phillips bit for drill
- Tape measure or yardstick
- Caulking gun
- Scissors
- Stapler
- Paintbrush

Construction Procedure

1. Measure and cut plywood into three pieces:
   - 26.5" x 24"  
   - 16.5" x 24"  
   - 5" x 24"

2. Measure and cut furring into one 24" and two 20 1/2" pieces.

3. Screw back to furring, caulking first. Start with 24" piece at top.

4. Staple the netting to inside surface of back, starting at the bottom.
   - Be sure netting lies flat (curve down) and does not pucker.

5. Screw front to furring, top piece first (don’t forget to caulk).
   - Leave 1/4" vent space between top and bottom front pieces.

6. Caulk around outside joints if needed to seal roosting chamber.

7. Attach a 3" x 28" board to the top as a roof, if desired.

8. Paint exterior at least twice.

Optional Modifications to the Small Economy Bat House

1. Wider bat houses can be built for larger colonies. Be sure to adjust dimensions for back and front pieces, ceiling furring strip, and netting. A 3/4" support spacer may be required in the center of the roosting chamber for bat houses over 24" wide.

2. Two bat houses can be placed back-to-back mounted on poles.
   - Before assembly, a horizontal 3/4" slot should be cut in the back of each house about 10" from the bottom edge of the back piece to improve ventilation and permit movement of bats between houses.
   - Two pieces of wood, 4" x 4 1/4" x 3 1/4", screwed horizontally to each side will join the two boxes. One 3" x 22" vertical piece, attached to each side over the horizontal pieces, blocks light but allows bats and air to enter.
   - Leave a 1/4" space between the two houses, and roughen the wood surfaces or cover the back of each with plastic netting. Do not cover the vents. A tin roof covering both houses protects them and helps prevent overheating. Eaves should be about 3" in southern areas and about 1 1/2" in the North.

3. Ventilation may not be necessary in colder climates. In this case, the front should be a single piece 23" long. Smaller bat houses should not be used in northern areas.

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Agriculture

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POST BAT HOUSE DESIGN 7/96
DANIEL BOONE NATIONAL FOREST
J. MACGREGOR/D. DOURSON

Bat house box should be at least 3' long.

Galvanized screws

Shingle roofing

Cut top of 4x4 post at a sharp angle and roughen. This is the area where most bats will roost.

Screened vent 1/2" to 3/4" in diameter

Additional cuts could be made to increase roosting area.

3/4" spacer (wood block) Use lug bolts to attach box to 4x4 post.

Top view (spacing)

3/4" spacing

5 1/2"

3/4"

Place at least 2 1/2-3' of post in ground.

Bats enter and exit here.

4x4 rough cut oak post, 12-16 feet long. The rough cut surface is important for bats as it allows them to climb the post.

3/4" plywood

Slightly round off post corners.
Bat Anatomy

Label the different parts of the bat using the words in the word box.

Muscular arm   Eye
Furry body   Nose
Sharp claws   Fingers
Sharp teeth   Hind feet
Ear   Wing

Little Brown Bat: This is Land Between the Lakes’ most common bat! It weighs about 8g and its wingspan is about 22cm. The brown bat likes to make its home in attics, barns, or boxes. It also hibernates and migrates to warm caves in the winter.

The Little Brown Bat’s diet is mostly insects. It can eat its own body weight in insects every night. That’s a lot of mosquitoes!
Research: Compare and Contrast

Bats and birds both have wings, but they aren’t the same! Use this venn diagram to compare and contrast some of their traits.
Fable: Why Bat Has no Friends

Many years ago, there was a great battle between the animals. The mammals on the ground and the birds in the sky began a terrible war that lasted for many weeks. Bat was very nervous about the war and did not want to be stuck on the losing side.

At first it seemed as though the birds would win. There were far more birds than mammals. They could swoop down and peck away at the mammals and then fly up out of harm's way before the mammals could attack.

Bat flew up to the birds. They swooped towards him, ready to attack! But bat flapped his wings and said, “Look! I have wings just like you. Do not attack me for I wish to fight on your side.” The birds huddled around, twittering, cawing and squawking to each other. Finally, they agreed that Bat could fight with them.

“What a wonderful choice I’ve made. With so many more birds than mammals I will be on the winning side for sure.” But the mammals were not that easy to defeat. Although there were fewer of them, they had sharp teeth and claws and were much larger than the birds.

To make matters worse, Bat awoke to a very windy day. The wind made it difficult for the birds to control their attacks. Before long it was clear that the mammals had won that day’s battle.

That night after the miserable defeat, Bat decided enough was enough. He flew down and joined the mammals. “What are you doing here?” roared the cougar, his paw raised to strike bat down. Bat opened his mouth wide to show his pointy teeth. “Wait,” he said, “I am one of you! See, I have teeth in my mouth like a mammal -- not a beak like a bird.”

The mammals pondered for a few moments and then agreed that Bat did indeed belong on their side.

The next day, the battle was again fierce. But this time the wind was gentle and the birds were able to organize. They pecked at the eyes of the mammals and flew away before they could be touched.

That evening, Bat snuck away from the mammal's camp and quietly flew back up into the sky to join the triumphant birds. When they complained that they had seen him on the mammal's side during the battle, Bat again flapped his wings and claimed to belong with the birds.

And so it went for many days. Whenever the birds won a battle, Bat would flap his wings and go with them. Whenever the mammals won a battle, Bat would bare his teeth and side with them.

Finally the animals grew tired of battling each day. The Chiefs held a meeting to make peace. They were all so exhausted, that it did not take long to reach a truce -- but during the process the mammals and the birds began to talk about Bat.
“It doesn’t seem fair that he just switched sides whenever he wanted,” squawked Crow.

“No, not fair at all,” growled Bear, “Bat has wings but he did not stay with the birds.”

“And he has teeth but did not always help the mammals,” added Crow.

All of the animals nodded and looked at Bat, “Because you could not choose your friends during war, you will not have them during peace. From this point forward, you will only fly at night when everyone else is sleeping. You will have no friends among the mammals or the birds.”

And that is why Bat doesn’t have any friends.

(The morale of the fable: Choose your friends carefully and remain faithful to them.)
ORIGAMI BAT

You will need: a square piece of paper and scissors. Look at the diagrams very carefully as you fold.

1. Fold the paper in half diagonally
2. Fold the long side of the triangle halfway downwards as shown
3 & 4. Fold the right part towards the lower tip then the left part in the same way
5 & 6. Fold the wings outwards with a fold
7. Fold both wingtips backwards
8. Cut away the paper between the ears
9. Turn the bat around and draw it a "face"
Directions for Whole Class Game

MATERIALS:
- Fat Bat Recording Sheets for each student (in sheet protector)
- dry erase markers
- one die

GAME DIRECTIONS:
- The teacher tosses the die and announces the result.
- Students write down that number in the B column on their Fat Bat Recording Sheets.
- The teacher tosses the die and announces the result.
- Students write down that number in the B column on their game mats.
- Play continues in this way until the die toss is a 1. When a one is tossed, every student still playing is a “fat bat” and loses all of their points for that round.
- A player may decide to stop at any point before the die is thrown again. He/she simply puts down the dry erase marker and stands quietly at the desk. Once standing, the student does not collect any more points. He/she gets to keep all of the points earned before standing.
- Play continues until a one is thrown, or until all students are standing.
- At this point, all students are seated and total up the points for the B round. Students may use a calculator, if desired. Students write their totals at the bottom of the B column.
- Continue playing in the same way for the A round and the T round.
- A game is three rounds. After the third round is completed, students add their scores for the three rounds and write this number in the Game Total box at the top of the recording sheet.
- Highest Game Total wins the game.

DATA ANALYSIS OPTION:
- After students have played the game several times, challenge small groups to come up with a “winning strategy” for the Fat Bat game. (e.g. stop when you have 20 points, stop when you get two sixes, stop when you have 10 numbers, etc.)
- Each small group announces their strategy and the reasoning behind their choice.
- Play the game again. Each member of the small group must play according to their winning strategy and may not alter their strategy during the course of the game.
- Announce game totals and debrief. Allow small groups to modify their winning strategy, if desired, before playing successive games.
- Let each group discuss how their best winning strategy competed with other groups’ strategies. Encourage groups to identify the strengths and weaknesses of each, and how each group figured actual probability into their winning strategy.
- Ask individual students write about what they learned about probability from the Fat Bat Game.
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Game Total
Additional Resources

Books for Students:

Bats at the Ballgame by Brian Lies
Bat Loves the Night by Nicola Davies
Little Red Bat by Carole Gerber
Nightsong by Ari Berk
Stellaluna by Janell Cannon
Bats by Kate Riggs
Amazing Bats by Eyewitness Junior
What is a Bat? by Bobbie Kalman
The Life Cycle of a Bat by Bobbie Kalman
Bats by Gail Gibbons

Websites:

Project EduBat: batslive.pwnet.org/edubat/curriculum.php
Bat Conservation Trust: bats.org.uk/pages/fun_batty_things_to_do.html
Bat Cam: www.zoo.org/batcam
White-nose Syndrome: www.whitenosesyndrome.org
EducationWorld: Bats in the Classroom, Activities Across the Curriculum:
http://www.educationworld.com/a_lesson/lesson/lesson031.shtml
Bat Conservation International: www.batcon.org
Organization for Bat Conservation: www.batconservation.org