Lessons in a Backpack

United Nations Educational, Scientific and Cultural Organization

GEORGIAN BAY BIOSPHERE MNIDOO GAMII Spirit of the Water

Bats are Brilliant!

Examining the Amazing Lives of Nocturnal Species at Risk

Endangered Little Brown Bat, by J. Segers

Description of Lesson

Through this lesson, students will recognize that bats are not scary but instead complex animals that have thoroughly adapted to their habitat and needs. They will gain an understanding of Ontario's bats structural adaptions, life histories, and echolocation. They will learn about the introduction and spread of White Nose Syndrome, and the serious threat it has on Canada's bat populations.

Connect with the Georgian Bay Biosphere

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GEORGIAN BAY BIOSPHERE MNIDOO GAMII Spirit of the Water

At a Glance

Grade Level: 4

Learning Environment:
Classroom and Outdoor Area

Prep Time: 20 minutes
(Print handouts, test the audio/video, test black light mixtures)

Length of Lesson: 2 hours (plus optional extension activities)

Key Vocabulary: Habitat, Population, Community, Echolocation, Insectivore, Nocturnal, Maternity Colony, Species, Natural, Infectious Disease

Staffing: 1 Educator

Materials:
1. Bat Skeleton
2. Stop Watch
3. Pantyhose
4. Wings
5. Two tubes taped to a table's edge
6. Cake pan
7. Myth cards and True/False board
8. Student worksheets
9. Station instructions and illustrations
10. 2 Rattles
11. Blindfold
12. Other Noise Makers
13. Book or Case Study
14. Habitat Worksheets
15. Video– Bats vs. White Nose Syndrome: What We Know!
16. Bat Cards

Activity Kit Available from the NNDSB Resource Centre.

Groupings: Whole class and small groups of 2-3 students

Teaching/Learning Strategies:
Discussion, Observing and Recording, and Kinesthetic Games

Lesson Outline

Time	Activity	Location	Materials
5 minutes	Introduction to BATS!	Indoor	Chart paper, White board, markers
45 minutes	How do Bats Compare? Learning Centres	Indoor	Bat skeleton, stop watch, wings, two tubes taped to a table's edge, cake pan, myth cards and True/False board, student worksheets, station instructions and illustrations
15 minutes	Bat & Moth Game	Indoor/ Outdoor	2 Rattles, blindfold, other noise makers
25 minutes	Little Brown Bat, What is your Habitat?	Indoor	A Little Brown Bat book by Melissa Kim or Case Study Habitat Needs Worksheets
20 minutes	A Fungus Among Us	Indoor	Video– Bats vs. White Nose Syndrome: What We Know! Bat Cards

Curriculum Expectations

Gr. 4 Science | Understanding Life Systems: Habitats and Communities

Overall Expectations

1. Analyze the effects of human activities on habitats and communities;
2. Investigate the interdependence of plants and animals within specific habitats and communities;
3. Demonstrate an understanding of habitats and communities and the relationships among the plants and animals that live in them.

Specific Expectations

1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities, taking different perspectives into account, and evaluate ways of minimizing the negative impacts

1.2 identify reasons for the depletion or extinction of a plant or animal species, evaluate the impacts on the rest of the natural community, and propose possible actions for preventing such depletions or extinctions from happening

2.3 use scientific inquiry/research skills to investigate ways in which plants and animals in a community depend on features of their habitat to meet important needs

2.5 use appropriate science and technology vocabulary, including habitat, population, community, adaptation, and food chain, in oral and written communication

3.7 describe structural adaptations that allow plants and animals to survive in specific habitats

Gr. 4 Science | Understanding Matter and Energy: Light and Sound

Overall Expectations

2. Investigate the characteristics and properties of light and sound;
3. Demonstrate an understanding of light and sound as forms of energy that have specific characteristics and properties.

Specific Expectations

2.3 investigate the basic properties of sound

2.5 use scientific inquiry/research skills to investigate applications of the properties of light or sound

3.6 describe how different objects and materials interact with light and sound energy

Background

Let's bust bat myths! Bats are not blind, they will not get tangled in a person's hair, and they are not flying rodents nor related to birds. Bats are in their own order of animals called Chiroptera (kye -rop-ter-a), meaning hand wing.

Ontario's Red Bat Source: B. Fenton

Bats are actually mammals, just like humans (i.e. they give birth to live young, their babies are nursed with milk, and they have fur). There are roughly 1,300 species of bat globally, considering there are roughly 4,000 mammal species about 1 in 4 mammal species is a bat. In Ontario, there are four endangered species of bat (Little Brown, Northern, Small-footed, and Tri-coloured) and four non-endangered species of bat (Red, Silver Haired, Hoary, and Big Brown).

Bats are the only mammals with adaptations that permit full powered flight. Mammals like the flying squirrel glide through the air. Flight has allowed bats to become widely distributed in the world. Bats are found on every continent except for Antarctica.

Most small mammals produce many young in a single litter, but most bats produce 1-2 offspring (called *pups*) per year. In Ontario, young are born in May or June and are cared for by the mother in maternity colonies. These colonies vary in size by species and location, there can be anywhere from 10 bats to thousands of bats! Young bats learn to fly within two to five weeks.

Ontario's bats are insectivorous, they snatch insects by mouth or scoop them into their tail or wing membranes. They then reach down and take the insect into their mouth. This gives bats an erratic flight. Bats drink on the wing and need clean, unobstructed drinking water sources.

Insect-eating bats (insectivores) eat primarily moths and other flying insects, many that are harmful to agriculture. Dr. Merlin Tuttle notes a study of 150 big brown bats that, in one summer, ate 600,000 cucumber beetles, 194,000 scarab beetles, 335,000 stinkbugs and 158,000 leafhoppers, all of them pests that damage crops and gardens. Some bats such as the Mexican long-nosed are important pollinators and seed dispersers. Many everyday products, such as wild bananas, mango, agave, avocados, dates, and allspice, come from bat-dependent plants.

Teaching and Learning

Part A. Introduction to BATS!

Introduce the topic of bats by asking students what they already know about bats.

Do we have bats in Ontario?

What do bats eat?

When are bats most active?

Use information in the background section to introduce students to bats. Many students will be familiar with Halloween cut-outs and cartoon images.

As a class, brainstorm the similarities and differences between bats and humans. Ensure students understand that bats are mammals, just like humans they give birth to live young, nurse babies with milk, and have hair. Record in a mind map on a whiteboard if possible.

Part B. How Do Bats Compare? Learning Centres

For this activity, divide students into groups of 2 or 3 to learn about bat adaptations by rotating through a series of learning centres. Prepare the centres and print the student worksheets beforehand. If your class has an iPad, load this video for Station 1. Bats in Slow Motion: www.youtube.com/watch?v=Ni_mS4cKPXY

Review each centre's instructions as a group. Ensure students are familiar with the equipment and concepts at each centre (Ex. Echo for the Finding Food station - ask them if they have noticed how their voices sound different in empty spaces, such as a gym. Use the station's image as a visual aid).

Divide students into pairs or small groups that will work together at each station. You may wish to provide the Student Worksheet, or simple ensure groups discuss their answers or take notes in a journal.

Allow 5-10 minutes at each station for students to work through the Instruction Sheet. Each student should keep track of their own results on their Student Worksheet.

After students have worked through all the stations, discuss as a group the adaptations unique to bats, such as their ability to fly thanks to elongated finger bones and their ability to use echolocation. Review how each adaption helps a bat survive in the wild. Have students complete any question not previously filled out.

Different Approach: Have one student from each station (an "expert") summarize which adaptation they explored in their station, and share the answers that they have recorded. Other students can follow along on their sheets completing and correcting.

The six stations are as listed and described below:

Station	Background	Students will….	Materials
#1 Fingers	A bat's wing is actually a modified hand. The types of bones are the same but the structures vary greatly. For a bat, the elongation of bones is required to support the wing membrane.	… look at the bat skeleton and illustration to compare hand and finger bones in bats, humans and birds.	Bat, human and bird illustration Bat skeleton Pantyhose iPad with video
#2 Wing Beats	Birds have hollow bones to lessen their body weight and make flying easier. Like other mammals, bats have solid bones. To support a body in the air, a bat must beat its wings very quickly to maintain altitude. The Little Brown Bat flaps its wings about 12 times a second.	… calculate their wing beats per minute to compare to a bats, and consider why a bat needs to flap its wings so quickly.	Stop watch Image of bat Wings
#3 Finding Food	Bats send out high-frequency sound waves, which bounce off all objects in their path and echo back to them, this is called echolocation. Based on retuning sound, bats can tell the distance, size, and shape of an object. Some bats can detect objects as fine as a human hair! The sound waves are mostly inaudible to human ears.	… mimic echolocation, one student speaks into a tube and another listens through a tube to the echo off the cake pan. … compare this strategy to how humans find food.	Two tubes taped to a table's edge Cake pan Echolocation image
#4 Myths	Bat species are some of the most misunderstood animals in the world. By busting myths about bats, people can be less afraid of these animals, learn amazing truths and help educate others.	... will sort common myths about bats into true and false categories.	Myth card
#5 Food	The world's bat species are grouped as either a megabat (fruit-eating) or microbat (primarily insect-eating bats). The bat species in Ontario are microbats, and they eat insects! While many of the worlds bats are insect eats, many also eat other foods and have interesting adaptions to help them do so.	... compare bat food sources and eating adaptions across the world – fish, fruit, nectar, insects and blood drinkers.	Five bat pictures Five bat food pictures Mega and micro bat labels
#6 Sleep	Bats are nocturnal, they sleep during the day and usually nap between two nightly feeding periods. Bats average 20 hours of sleep a day! Their feet are adapted so they can safely hang upside down while roosting.	… record the hours humans and bats are awake and compare how this helps in their respective habitats.	Image of bat sleeping upside-down

Station 1 Instruction Sheet

FINGERS

Bats and birds are both true fliers, which means they power their own flight instead of gliding or jumping. Bat wings consist of flaps of skin stretched between the bones of the fingers and arm. Bird wings consist of feathers extending all along the arm.

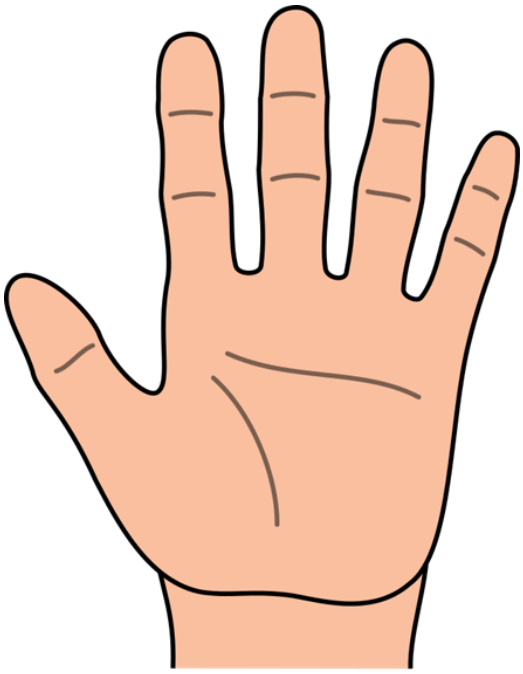
Look at the bat skeleton and the illustration. If your class has an iPad, watch the slow-motion video of a bat flying.

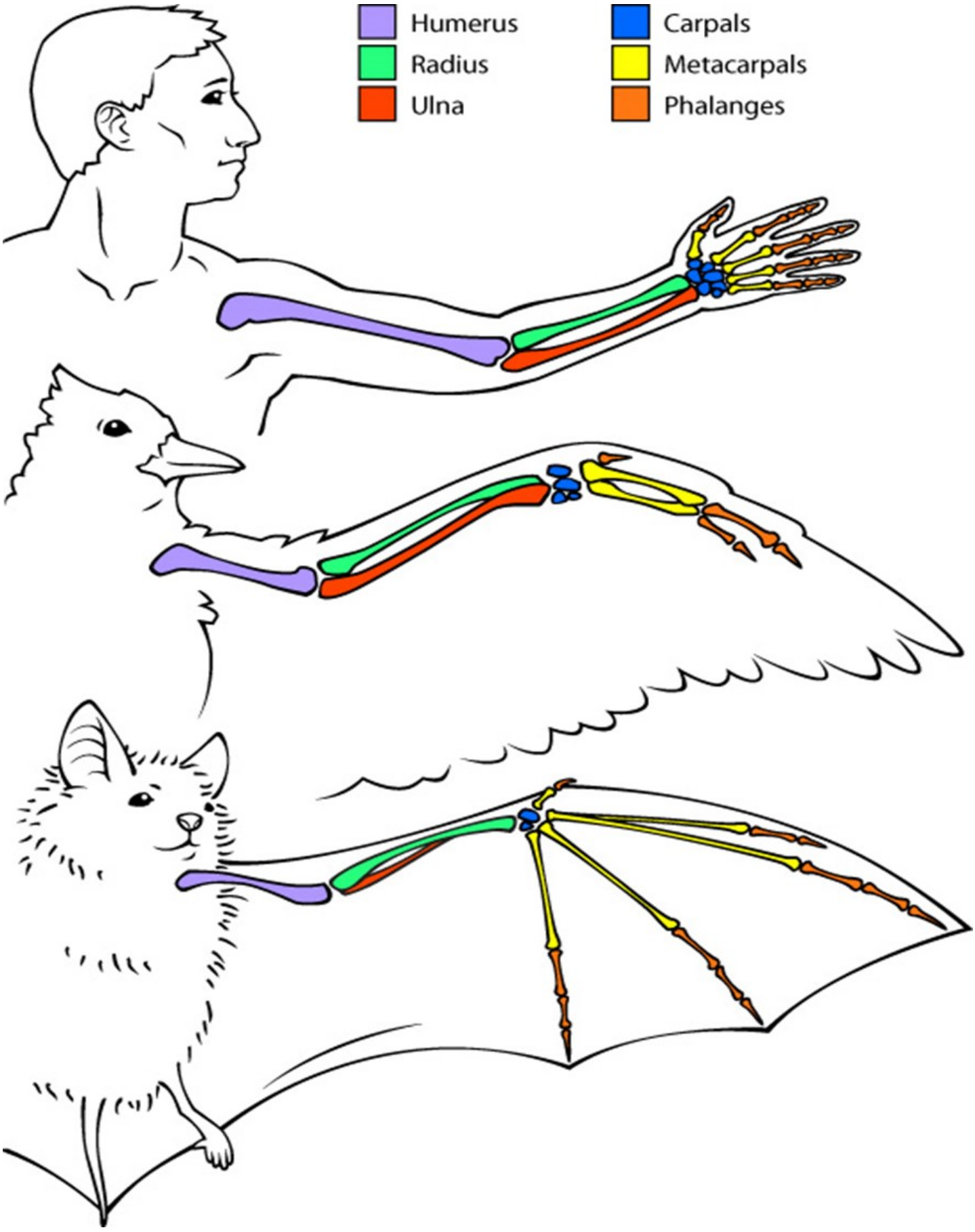
Now put the pantyhose over your hand and spread your fingers. Can you move your fingers the way a bat moves its wing?

Compare the bones of your hand to those of a bat and a bird.

How might a bat's hands and wings help it to survive? (think: how do *your* hands help you?)

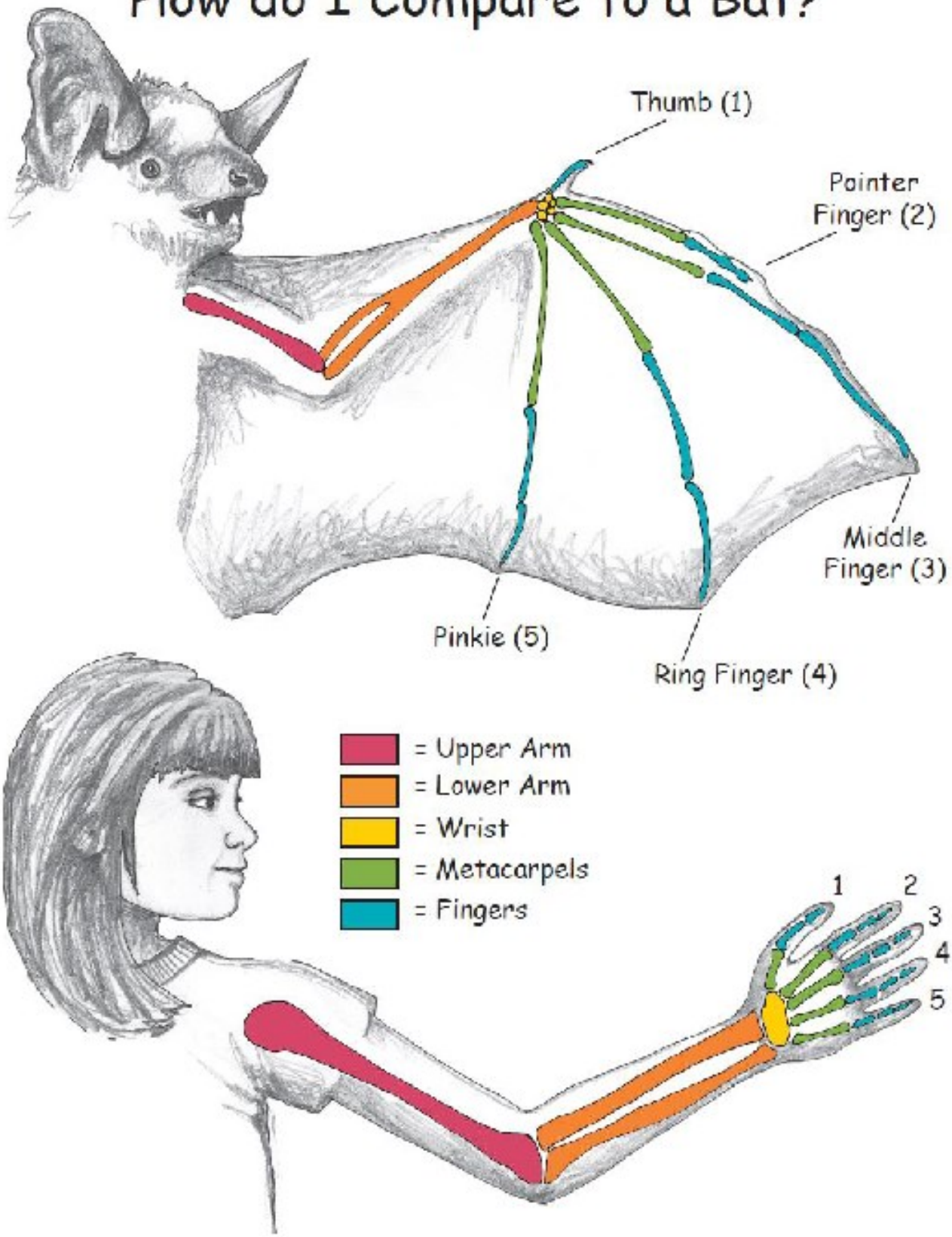
What might a bat use its thumb for? (think: what do *you* use your thumbs for?)





Credit: https://askabiologist.asu.edu/human-bird-and-bat-bone-comparison

How do I Compare to a Bat?



Credit: https://www.batslive.pwnet.org%2Fedubat%2Ffinal_how_do_I_compare_to_a_bat_west.pdf

Station 2 Instruction Sheet

WING BEATS

Birds have hollow bones which makes them lighter and makes flying easier. Like other **mammals**, bats have solid bones. To support their body in the air, a bat must beat its wings very quickly.

The Little Brown Bat flaps its wings about **12 times a second**.
QUESTION: How many times would the Little Brown Bat flap its wings in 1 minute?
(*Hint: there are 60 seconds in one minute)*

Put on the imitation bat wings if you'd like.

To determine wing beats per minute, flap your arms like a bat for **30 seconds**. Count the number of times you flap out loud so you don't lose track.

Your partner will tell you when to begin and when to stop using a stopwatch or clock.

Multiply the number of wing flaps **times 2** to find the rate per minute.
Record your answer.

Try it again and see if you can beat your last time!

Station 3 Instruction Sheet

FINDING FOOD

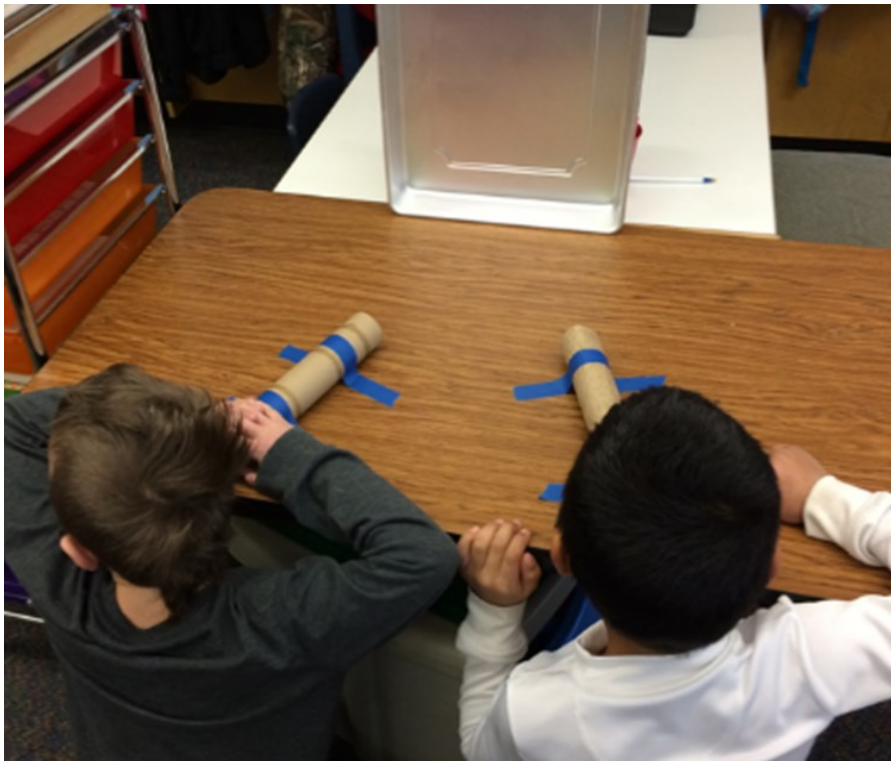
Bats can see as well as other animals, but vision isn't enough to find flying insects to eat at night.

Bats have a way of “seeing” with sound. **Echolocation** helps them navigate in darkness. Bats send out sound waves, which reflect off objects and back to them. Based on the returning sound, bats can tell the distance, size, and shape of an object.

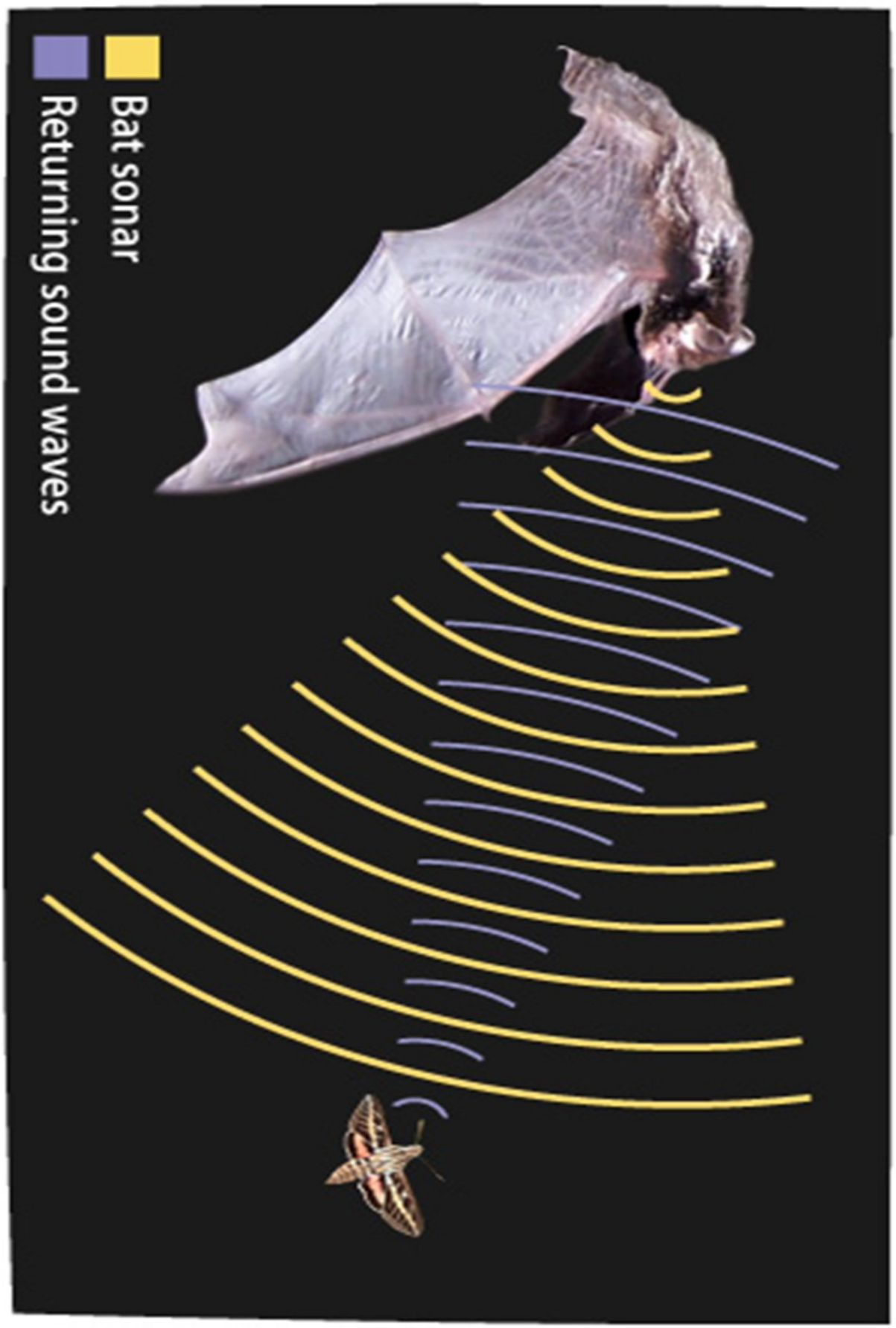
One person will speak quietly into one tube facing the cake pan, while the other person listens through the other tube.

How well can you hear your partner?

QUESTION: Can you think of another animal that uses sound to find food?
QUESTION: What other senses to animals use to find food?
QUESTION: How does this compare to how you find food?



Source: betterlesson.com



Credit: https://askabiologist.asu.edu/echolocation

Station 4 Instruction Sheet

MYTHS

It's time to bust bat myths! When we sort out what is fact and fiction, we will learn that bats are not scary after all. In fact, bats are very important!

To bust bat myths, use The Liar's Club game.

Take turns reading each group of statements. Two statements are myths while the other one is true. See if you can guess which is the truth!

Which truth surprised you the most?

Station 4. The Liar's Club

Group 1.

A. People think bats are blind because they eat bugs, they must be blind! Gross!

B. People think bats are blind because their ears are bigger than their eyes, they must be blind!

C. People think bats are blind because they hunt at night and use sound to find their way, but they see as well as people.

Group 2.

A. Many bat species are *endangered*, and may soon be extinct.

B. There are more bats alive today then ever before.

C. Bats are not facing different, man-made threats around the world.

Group 3.

A. Bats can get caught in your hair.

B. Bats cannot detect objects as fine as human hair using echolocation.

C. Bats only swoop around people to eat nearby insects.

Group 4.

A. One in four mammal species in the world is a bat.

B. One in ten animal species in the world is a bat.

C. There are only 100 species of bat.

Group 5.

A. Bats are flying mice.

B. Bats are related to birds.

C. Bats are closely related to humans.

The Liar's Club Answers

Group 1.

A. People think bats are blind because they eat bugs, they must be blind! Gross!

B. People think bats are blind because their ears are bigger than their eyes, they must be blind!

C. TRUE People think bats are blind because they hunt at night and use sound to find their way, but they see as well as people.

Group 2.

A. TRUE Many bat species are *endangered*, and may soon be extinct.

B. There are more bats alive today then ever before.

C. Bats are not facing different, man-made threats around the world.

Group 3.

A. Bats can get caught in your hair.

B. Bats cannot detect objects as fine as human hair using echolocation.

C. TRUE Bats only swoop around people to eat nearby insects.

Group 4.

A. TRUE One in four mammal species in the world is a bat.

B. One in ten animal species in the world is a bat.

C. There are only 100 species of bat.

Group 5.

A. Bats are flying mice.

B. Bats are related to birds.

C. TRUE Bats are closely related to humans.

Station 5 Instruction Sheet
FOOD

There are about 1,400 species of bat in the world!

Each bat belongs to one of these groups:

Megabats

- Diet primarily consists of fruits.
- Majority of megabats cannot echolocate and find it difficult to track insects.
- Generally have smaller ears and large eyes with very good vision.
- Size ranges from 6 - 40 cm depending on species.
- Some megabats are actually smaller than microbats.

Microbats

- Most bat species are microbats.
- Use echolocation, to 'see in the dark' while moving or hunting.
- Emit sound waves through their nose or mouth.
- Have large ears, smaller eyes, and some have a tail.
- Unlike megabats, they lack underfur and the claw at the second finger.

All eight bat species in Ontario are microbats and **insectivores,** they eat insects! While many of the world's bats are insect-eaters, many also eat other foods and have interesting adaptions to help them do so.

There are five pictures of different bat foods, can you match the food to the bat?

Go though one bat at a time.

Read the clues and look at their body's adaptions for clues.

Label each bat with a Megabat or Microbat tag.

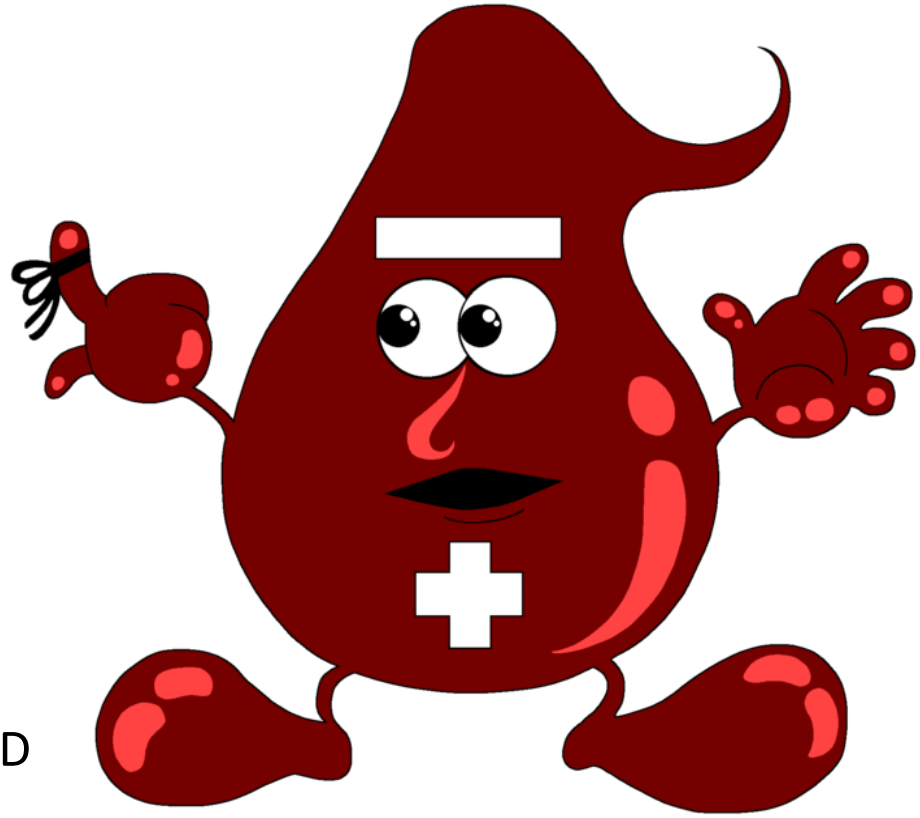
Check the back of the cards to see if you were right.


ARKive
www.arkive.org
Toes are very large, legs and claws are very long. Can grab items out of the water.
© Marco Tschapka, Univ. Ulm, Germany

Strong legs for climbing on prey.

Sharp teeth.

Heat sensitive nose.



BLOOD


Ears designed to help echolocation.
Long narrow wings for speed.
Sharp teeth for grinding and chopping hard bodied foods.

Large eyes with good vision.

No tail.

Keen nose and sense of smell, small ears.

Flat grinding teeth.

Small body.

Long, slender snout and tongue.

Rough, scaly tongue.

Small teeth.

Cut out each label and have students use sticky tac to attach it to the corresponding bat picture.

Megabat (smaller ears, larger eyes)

Megabat (smaller ears, larger eyes)

Megabat (smaller ears, larger eyes)

Megabat (smaller ears, larger eyes)

Microbat (large ears, smaller eyes)

Microbat (large ears, smaller eyes)

Microbat (large ears, smaller eyes)

Microbat (large ears, smaller eyes)

Station 6 Instruction Sheet

SLEEP

Write down the hours you normally wake up and go to bed.

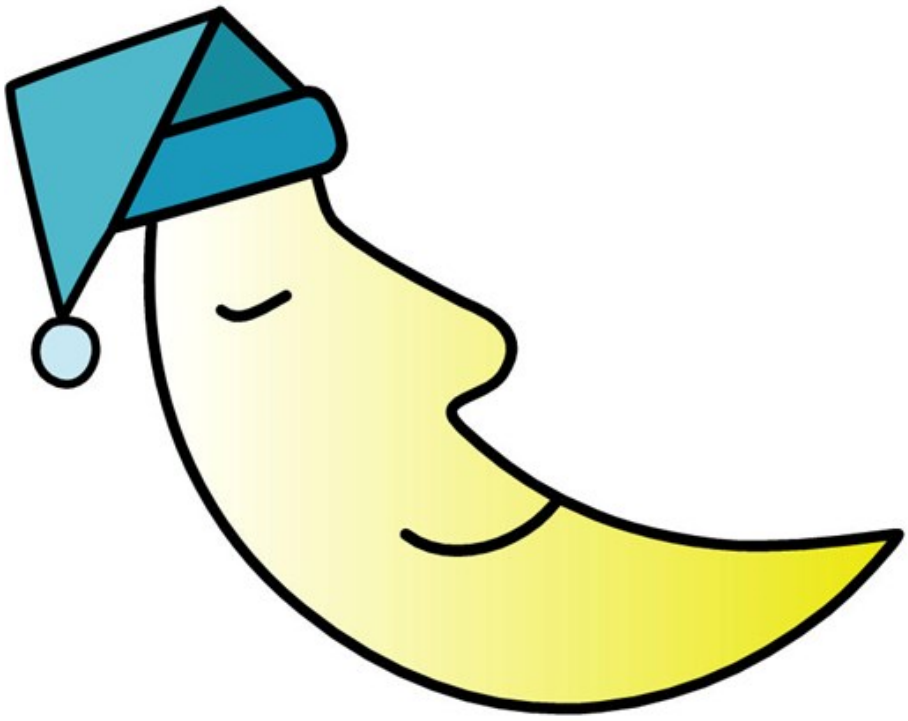
Now count, how many hours do you sleep?

Estimate the hours that bats normally wake up and return to their “beds”, called roosts. Look on the back of the bat image, were you correct?

An animal that sleeps during the day and finds food at night is called **nocturnal**.

How does being nocturnal help bats survive?

What *adaptions* might help a bat to be nocturnal?




Credit J. Segers

Station 6

SLEEP

Ontario's Little Brown Bats sleeps about 20 hours every day!

Ontario's eight bat species will usually emerge shortly after sunset to forge for insects.

They will return to their sleeping spot, called a **roost**, for a midnight nap. Then re-emerge for a second time to forage for insects shortly before the sun rises. This is in the spring, summer, and fall.

In the winter, Ontario's bats **hibernate**. Their bodies slow down and they are able to conserve energy and stay sheltered from cold temperatures.

How do bats compare?

Student Worksheet **Name:** _____

You will visit six stations to learn how bats adapted to their environments.

Read the questions on each station card. Discuss with your group or record your answers below.

STATION 1. FINGERS

_____

_____

_____

_____

STATION 2. WING BEATS

If a bat flaps its wings 12 times a second, how many times would it flap its wings in 1 minute?

_____

How many wing beats per minute can you flap your arms?

_____

STATION 3. FINDING FOOD

_____

_____

_____

_____

STATION 4. MYTHS

Which truth surprised you the most? Why?

_____

_____

_____

_____

STATION 5. FOOD

How many microbats were at the station?

_____

How many megabats were at the station?

_____

What are the bat's different food sources? _____

_____

STATION 6. SLEEP

How many hours do you sleep? _____

Estimate the hours that bats normally wake up and return to their roosts. _____

How does being nocturnal help bats survive?

_____

_____

_____

How do bats compare? Teacher Copy

1. FINGERS
A bat's wing is actually a modified hand. The elongation of bones is required to support the wing membrane. The membrane of a bat's wing is living tissue similar to the tiny flaps of skin joining the bases of human fingers. Because the membrane joins their fingers from the bases to the tips, a bat's fingers cannot flex independently. The muscles in the arm open up the wing. This system provides bats with lightness and maneuverability.

What are the similarities and differences in bat and bird wings?
Both wings provide full powered flight, but students should see how the bones have changed. A bat's wings contain finger bones (this permits more efficient flight). What students will not see is that bats bones are not hollow like a birds.

What is the same about the hands and arms of humans, bats and birds? *All bones are present, but they are arranged differently and serve different purposes.*

How might a bat's hands and wings help it to survive in the wild? *Flight is necessary for bats to catch flying insects and to access their roosts.*

What would a bat use its thumb for? *The thumb, usually with a sharp claw, is not attached in the membrane but is free to help the bat crawl.*

2. WING BEATS
If a bat flaps its wings 12 times a second, how many times would it flap its wings in 1 minute? *720 times*
How many wing beats per minute can you flap your arms? *Expect 20 – 30 times*

3. FINDING FOOD
How well can you hear your partner? *If done properly students should be able to hear each other well*
Can you think of another animal that uses sound to find food? *Dolphins, some whales, some birds, some rodents*
What other senses to animals use to find food? *Sight, sound, smell, taste, touch*
How does this compare to how you find food?

4. MYTHS
How many myths did you correctly label?
Which false myth surprised you the most?
Which truth surprised you the most?

5. FOOD
How many microbats were at the station? *4*
How many megabats were at the station? *1*
What are the bat's different food sources? *Insects, pollen, blood, fruit, fish (others include meat such as frogs and birds)*

Bat species: Fish eaters *Myotis vivesi*
Blood *Desmodus rotundus*
Insects Big Brown
Fruit – Indian fruit bat
Tube-lipped Nectar Bat

STATION 6.SLEEP
How does being nocturnal help bats survive? *Nocturnal animals may experience less competition with other animals for food. There may also be a reduced risk of predation.*
What adaptions might help a bat to be nocturnal?
Bats sleep upside down. (They huddle together for protection from cold and predators).
Echolocation (good vision isn't enough to see flying insects at night)
Dark colour (most of Ontario's bats are black or dark brown, which helps them to avoid being seen at night)

Part C. Bat & Moth Game

Review with students that bats send out high-frequency sound waves from their nose or mouth, which bounce off all objects in their path and echo back to them. Based on retuning sound, bats can tell the distance, size, and shape of an object. The squeaking sounds people can hear from bats made between mothers and pups and aren't considered echolocation. This activity doesn't use echoes, which are difficult for the human ear, but students will practice using sounds.

Recap with students: Ensure students have an understanding of echolocation from the first activity.

Choose one student to be a bat. Have all other students form a circle joining hands. These students will be the trees in the forest.

Blindfold the bat and provide the rattle. Choose another student to be a moth and provide the other rattle. Encourage the moth to walk slowly around the classroom.

Every time the bat shakes the rattle the moth will shake their rattle in response. The bat will try to zero in on the moth by following the sound of the rattle, simulating echolocation. If the bat runs into a tree, the student will say “tree.” Once the bat tags the moth, the moth becomes a bat and the bat becomes a tree.

Blindfold the bat and then choose another moth. You can vary the game by adding more than one moth or adding wind to the trees increasing the difficulty for the bat to hear.

See Extension Activity 1 for another version of this game.

Habitat 101

A habitat is where an animal or plant lives and gets everything it needs to survive: **food, water, shelter** and **space to live**.

Within a habitat there are **microhabitats**, areas where conditions vary from the habitat as a whole. Example: a tree cavity may be warmer, more humid, and less windy than the surface of the tree.

Habitat includes the entire area that contains the components needed by a plant or animal. While thinking of habitat as a plant or animal’s home is a good way to explain habitat, it is much bigger than a house. Habitat is the **neighborhood** where food, water, shelter, and space are found.

Photo: J. Segers

Part D. Little Brown Bat, What is Your Habitat?

Background, or discuss with students:

Bats use various habitat types depending on the species, season, and activity. In order to survive, Ontario's bats need insects to eat, water to drink, places to sleep and raise young, and places to hibernate in winter. Rivers, ponds, and lakes are used by bats because many species hunt for insects over water and almost all need to drink daily. Some bats use cavities such as caves, rock outcrops, cliff faces, or even tree bark to roost, hibernate, and raise young. Bats are also found in human made structures - houses, barns, attics, cellars, tunnels, mines, bridges, and aqueducts. In summer, Little Brown Bats roost in human-made structures, under tree bark, in rock crevices and tree hollows. Pregnant females select roosts (*maternity colonies*) based on temperature and shelter. Maternity colonies are often found in dead or dying trees in crevices or hollows. Maternity colonies do not occur in caves because warmer temperatures are needed to raise young.

Assess your students' knowledge of habitat needs by asking:

What do humans need to survive?

What do plants and animals require to live?

Do all animals live in the same place?

Do they need the same amount of space?

Guide your class in generating a list of habitat needs by asking them if they have pets. Considering different pets will illustrate how animals have basic needs. Ask the class what a pet cat needs to live and stay healthy? How about a hamster? If a student has another pet, allow them to describe what their pet needs to live and stay healthy.

Tell students that a habitat is the place where an animal or plant lives and gets everything it needs to survive. These needs can be grouped into four categories: food, water, shelter, and space to live. See if your students can determine these categories by working through these questions:

What factors do you think about when taking care of these pets?

Can all pets live in a small tank or cage? Why or why not?

Could the cat and the hamster live in the same space?

Would these animals survive outside in the summer? What about in winter?

Challenge your class to group the list of the pets' needs that they created into the four categories: food, water, shelter, and adequate space to live. Shelter may mean protection from predators or protection from the sun, snow, or other elements. You can do this by assigning a colour to each category and circling the needs based on which category they best fit into.

Change student's thinking from pets towards animals in the wild.

Ask the class to describe a forest.

Have they ever visited a forest?

How is it different than their home?

What was it like in the forest?

What kinds of things did they see while they were there?

What kind of animals live in a forest?

How do the needs of wild animals differ from pets?

Tell the students that they are going to learn more about habitat by reading about Little Brown Bats.

Little Brown Bat, What is Your Habitat?
#1. Younger Ages

Give students copies of the Habitat Needs Worksheet. Students will first label each section as one of the four components of habitat - food, water, shelter, space. Students will write notes or draw pictures of the components of a Little Brown Bat's habitat in the appropriate section.

Read "A Little Brown Bat Story" by Melissa Kim aloud.

Discuss the following questions:

What do we know that bats need?

What animals are in the bat's food chain?

What else lived in the bat's tree?

What are some of the non-living parts of the bat's natural habitat?

How did the habitat meet the needs of the Little Brown Bat?

Can a bat's needs be meet anywhere?

What were some of the ways the bat's body was adapted to the habitat?

How can we minimize negative impacts?

What would happen to the bat if the tree in which they live in fell to the ground?

What is the bat's home and what is the bat's neighborhood?

Discuss how the forest provides food, water, shelter, and space for bats. Review the Habitat Needs Worksheet as a group.

Outdoor Opportunity: Visit a forest to gather ideas about what the forest might provide in terms of habitat for wild animals and bats in particular.

#2. Older Ages

Divide students into groups of 4-5. Provide each student with the Habitat Needs Worksheet and each group with a copy of the “The Case of the Hibernating Bats”.

Read through the information as a class. Then allow 10 minutes for groups to discuss solutions and write out their ideas.

After 10 minutes, have each group share their ideas with the class.

Discuss as a class:

> *What common ideas did groups have?*
>
> *Is there an ideal solution that pleases all interest groups involved?*
>
> *Do you think these problems actually exist in Canada and other countries?*

Alternatively, assign each group member a different role in the scenario and have them debate a solution while representing their interest group.

Part E. A Fungus Among Us

Adapted from Earth Rangers White-Nose Wipeout

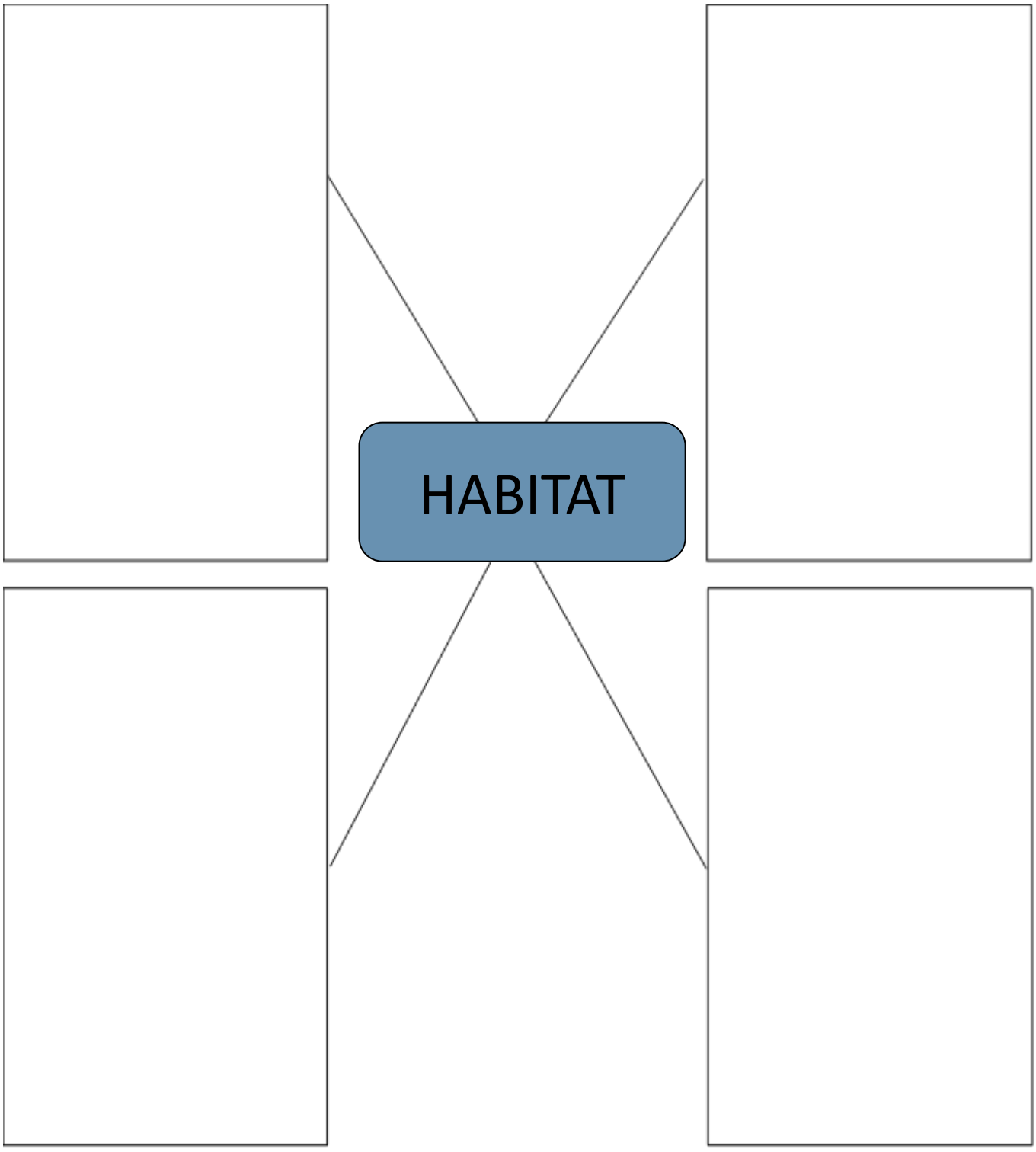
Create the following table on a blackboard or whiteboard to complete during the activity.

If you are outside or in a gym, use a large piece of paper.

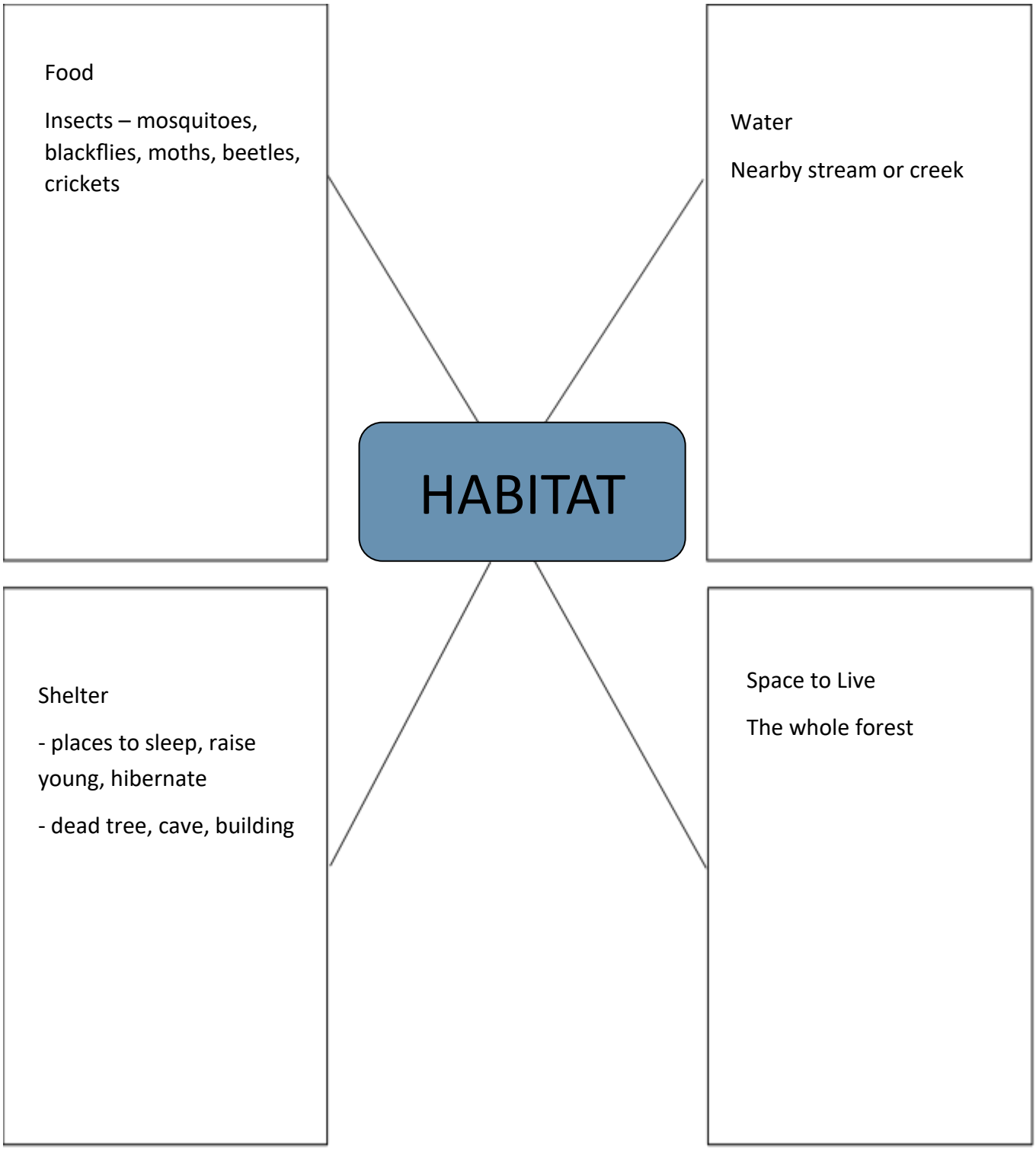
Round	Infected	Non-Infected
1		
2		
3		
4		
5		

Habitat Needs Worksheet

Name: _____ Date: _____



Habitat Needs Worksheet - Answers



Case Study: The Bats of Silver Cave

Case Study Roles: Cave Explorers, Conservation Group, Outdoor Adventures Inc.

Silver Cave

Silver Cave in Ontario is an important winter **hibernation** site for bats. It is home to seven species of bats, and there can be up to several thousand bats hibernating in the cave over the winter. The bats are insect-eating species that help keep insect populations in balance for farmers who live nearby. Unfortunately, the population of bats in this cave is declining because people who explore the cave in the winter are disturbing the bat **roosts**. This forces bats to wake up and waste their stored fat, many may starve before hibernation ends in the spring.

Cave Explorers

Many cave explorers like to visit Silver Cave because it is very large, holds interesting geological features, and has historical value. Many are careful not to disturb formations or creatures living in the cave, but a few are careless and some visitors who are afraid of bats have intentionally killed bats and vandalized the cave. Responsible cave explorers share the Conservation Group's concern for protecting bats, though they fear being excluded from the cave.

Outdoor Adventures Inc.

For over twenty years Outdoor Adventures Inc. has sold guided hikes, canoe trips, and cave tours for people. They want to expand their businesses by purchasing a large area of land including and around Silver Cave from a mining company that has been inactive for 50 years. There are many cave explorers and other people who will buy tours of Silver Cave. Outdoor Adventures Inc. knows some people in the past have vandalized the cave, but they don't know people have intentionally harmed the bats. The business owners enjoy nature and wildlife very much, but they need to see their business grow.

Conservation Group

Five of the bat species living in Silver Cave are endangered, and if they continue to be disturbed they may become **extirpated** (extinct in one area but the species continues to live elsewhere). The only sure way to protect the bats is to build a gate at the entrance of the cave that will allow bats to fly in and out but will prevent unauthorized people from entering (this has been done at other large caves). The Conservation Group has fundraised for two years to buy the land around the cave from the mining company, but Outdoor Adventure Inc. is already making plans for the area and they have many people interested in cave tours.

If everyone agreed to protect the cave, it would be difficult and expensive to build a large, protective gate. If no one agrees to protect the cave, the bat species could become *extirpated*.

Case Study: The Bats of Silver Cave

Questions:

How could the Conservation Group work with the other groups to save this habitat?

What other businesses, groups or people should have their opinion heard in this situation? What might they say?

What solutions can you think of for this conservation problem?

Is it possible that these groups could compromise, and what would that compromise be?

Case Study: The Bats of Silver Cave

Teacher's Notes

There are no right or wrong answers to this assignment. Real world scenarios are complex and subjective. Here are some possible outcomes your students may consider.

How could the Conservation Group work with the other groups to save this habitat?

The conservation group could host a meeting with all other groups involved.
The conservation group could meet one-on-one with Outdoor Adventures Inc. to discuss a compromise.
The conservation group could speak with the mining company about their concerns.
The conservation group could speak to local government officials to gain support.

What other businesses, groups or people should have their opinion heard in this situation?

The mining company who is selling the land.
The local farmers who are helped by bats as they eat insects.
The people interested in cave tours from Outdoor Adventures Inc.
Other groups who've built large gates at caves.
Local government.
Research groups.

Is it possible that these groups could compromise, and what would that compromise be?

If Outdoor Adventures Inc. purchases the property, the conservation group could use their fundraised money to install a large gate at the cave entrance.
The conservation group could purchase the land and allow Outdoor Adventures Inc. to use it at no cost, if they agree to avoid the cave.

Assess students' knowledge of infectious disease by asking:

How do people get sick?

What are some symptoms?

How do we keep from getting sick?

Do wildlife species get sick?

What symptoms do they have?

Clarify the difference between infectious and non-infectious diseases (e.g. nutritional, genetic). Tell students they are going look at an infectious disease that is killing bats in North America.

Watch "Bats vs White-Nose Syndrome: What We Know!" at: www.youtube.com/watch?v=bb41H7h07Y4

Discuss the video with students:

Do wildlife diseases occur naturally?

What does the disease look like?

Why did WNS spread quickly?

What happens to infected bats?

Why is bat population hard to determine?

Explain to students they're going to do an activity to track how a wildlife disease would spread in the class. To do this the class will become a bat population! As a group, estimate how many bats in the classroom will become WNS infected.

Move to your playing area and distribute one bat card to each student. For the beginning, all students should wear the bat cards with "I'm a healthy bat!" displayed.

White-Nose Syndrome Background

White-Nose Syndrome (WNS) is caused by a cold-loving fungus named *Pseudogymnoascus destructans* (Pd). The term comes from the visible white growth of the fungus on the muzzle and other parts of the bat. First detected in New York in 2006, there is concern WNS will spread across North America. WNS has killed more than six million bats and has caused population declines greater than 90% in some populations. Because of the low reproductive capability of most bats (1-2 pups a year) it is difficult for the population to recover.

Bat species affected by WNS survive winter by hibernating. During hibernation, there is little food, so survival depends upon fat deposits. Bats affected by WNS arouse more frequently during hibernation than unaffected bats, quickly depleting their fat reserves. Bats with WNS often exhibit unusual behavior, such as flying during the day in near-freezing weather.

During hibernation, bats often cluster together which allows for the direct transfer of fungal spores. Transmission between bats during the fall during mating is also likely. Fungal spores are deposited on roost walls and ceilings when infected bats touch these surfaces. Once a cave or mine is contaminated, it remains contaminated and can serve as a reservoir to uninfected bats that visit. It is also possible that humans and other animals moving between caves may carry fungal spores from one place to the next.

Signs of WNS infection include the white fuzzy growth on skin and wing membrane damage. Not all infected bats display signs and other means are required to diagnose infection. Ultra-violet (UV) light causes WNS fungi that are invading skin cells to glow and it can be used as a screening tool. Currently, effective treatments do not exist.

Allow 30 seconds for students to select a winter hibernate spot. Tell students to hibernate in groups of 3-4 (this will simulate bats roosting in clusters). They can select any spot in the room, which will serve as a cave, or hibernacula.

In the first round, the students should close their eyes and remain standing to pretend they're hibernating. The teacher will play the infected bat and should begin by hibernating without other bats.

Start near one student to tag. Tell the class you'll take 5 steps out of the cave to look for food and may infect students that you pass. If a student is tagged they should open their eyes and flip their bat card over to signify they've been infected. Once you've tagged a student, pretend to unsuccessfully search for food and return to hibernation. Pause to update the chart.

In the second round, tell students that you and the infected bat have woken up and are hungry and itchy! You're going to look for food once more. You and the tagged student will take 5 steps toward a cluster of bats and tag each student that you pass.

Tagged students will open their eyes, sit down, and flip their bat card over to signify that they've been infected. (Depending on the size of the space, the number of steps taken each round can be modified).

Sadly, after two rounds of moves, the effects of WNS are devastating and you have succumb to the fungal disease. Remove your bat tag and update the chart.

Tagged students will continue to spread WNS by taking 5 steps towards a bat colony. Tell students when tagged they have only two rounds before they succumb to WNS, at which point they'll sit and remove their bat tags.

Continue until 90% of students have been tagged. Explain that some bat colonies have been entirely wiped out over one winter.

Discuss the results as a class.

Did WNS spread through the class faster or slower than expected?

How significant is the effect of WNS?

How does WNS impact the natural community? (e.g. insect population)

How does WNS impact human activities?

How can I, my community and other people help bat populations?

How we ensure that another wildlife disease like WNS won't be introduced?

Healthy Bat

Infected Bat

Extension Activities

Activity 1: Maternity Colony Game (A Version of the Bat & Moth Game)

Explain to students that for bat species who have large maternity colonies (gatherings of pregnant or nursing females and young) sound plays another important role. Mother bats use sound to find their baby in crowded spaces.

Select one student to be the mother bat and one student to be the baby bat. The baby bat will choose a sound such as hand clap, chirp or tongue click. Ensure the mother bat hears this sound before the activity starts.

Have the rest of the class (or several students) stand in a line. Blindfold the mother bat and have her stand on the other side of the classroom. The students in a line will all make different noises as the blindfolded mother bat walks towards them. (You may need to help guide the mother bat).

Instruct the mother bat to point to in the direction of the baby bat when they think they hear the right noise. Are they correct?

Repeat the activity several times using different noises, volumes, musical instruments, or percussion. You can also modify the activity so the mother bat is not blindfolded, but does not know which classmate is the baby bat. Which noises are easier to identify? Why does this strategy need to be different from echolocation? Is this a good strategy for a mother bat to find her baby?

Activity 2: Be a Bat Researcher

Watch Bat Monitoring on American Prairie Reserve on microphones used to record bats (www.youtube.com/watch?v=x8Eeux7BkBI). Contact a local environmental group or the Georgian Bay Biosphere staff to learn more about the equipment that is used to record bats. Students can also practice ‘colony counts’, researchers simply count how many bats exit at dusk to estimate the number of bats in a roost or bat house. At the beginning of recess, have your class attempt to count the number of students exiting a doorway. Compare students results with the number of students in each exiting class.

Activity 3: Bats at the Dinner Table

Read through ‘Going to Bat for Bats, A Cookbook of Goodies and Treats Made with Bat Dependent Ingredients’. Discuss how bats in other parts of the world are important pollinators for food crops, and how insect eating bats control pests that like to harm crops. Have students think of their favourite meals. How many would depend on bats?

Activity 4: Positive Bat-itude

Have students create an awareness project for White Nose-Syndrome and why people need bats. Students can make posters or do a creative writing exercise.

Additional Resources

Discover Bats: The Multimedia Education Kit About Bats (2009)

Bats Live – Project EduBat https://batslive.pwnet.org/edubat/index.php

Canadian Wildlife Federation www.cwf-fcf.org

References

Bat Conservation International. (2017) Bat Week - Going to Bat for Bats, A Cookbook of Goodies and Treats Made with Bat Dependent Ingredients www.batweek.org/pdfs/go-to-bat-for-bats/BatCookBook-FinalDraft- 29August2017.pdf

Discover Bats: The Multimedia Education Kit About Bats (2009). Bat Conservation International

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Ontario