ROYAL BC MUSEUM

BATS

Of British Columbia

K–1 & Grades 3–4 Outreach Kit

September 13, 2023

What's Inside

Front cover image by Jared Hobbs M.Sc., R.P.Bio.
Photographer / Biologist

BC CURRICULUM LINKS

Science K

BIG IDEA: Plants and animals have observable features.

CURRICULAR COMPETENCIES	CONTENT
Questioning and predicting • Observe objects and events in familiar contexts • Ask simple questions about familiar objects and events	• Basic needs of plants and animals • Adaptations of local plants and animals • Living things make changes to accommodate daily and seasonal cycles
Planning and conducting • Make exploratory observations using their senses • Make simple measurements using non-standard units	
Processing and analyzing data and information • Experience and interpret the local environment • Discuss observations	
Applying and innovating • Take part in caring for self, family, classroom and school through personal approaches • Generate and introduce new or refined ideas when problem solving	
Communicating • Share observations and ideas orally • Express and reflect on personal experiences of place	

Science 1

BIG IDEA: Living things have features and behaviours that help them survive in their environment.

CURRICULAR COMPETENCIES

Questioning and predicting
- Demonstrate curiosity and a sense of wonder about the world
- Observe objects and events in familiar contexts
- Ask questions about familiar objects and events
- Make simple predictions about familiar objects and events

Planning and conducting
- Make and record observations
- Make and record simple measurements using informal or non-standard methods

Processing and analyzing data and information
- Experience and interpret the local environment
- Sort and classify data and information using drawings, pictographs and provided tables
- Compare observations with predictions through discussion
- Identify simple patterns and connections

Evaluating
- Compare observations with those of others
- Consider some environmental consequences of their actions

Applying and innovating
- Take part in caring for self, family, classroom and school through personal approaches
- Generate and introduce new or refined ideas when problem solving

Communicating
- Communicate observations and ideas using oral or written language, drawing, or role-play
- Express and reflect on personal experiences of place

CONTENT

- Classification of living and non-living things
- Names of local plants and animals
- Structural features of living things in the local environment
- Behavioural adaptations of animals in the local environment

Science 3 & 4

BIG IDEA: Living things are diverse, can be grouped and interact in their ecosystems.

CURRICULAR COMPETENCIES

Questioning and predicting
- Demonstrate curiosity about the natural world
- Observe objects and events in familiar contexts
- Identify questions about familiar objects and events that can be investigated scientifically
- Make predictions based on prior knowledge

Planning and conducting
- Safely use appropriate tools to make observations and measurements, using formal measurements and digital technology as appropriate
- Make observations about living and non-living things in the local environment
- Collect simple data

Processing and analyzing data and information
- Experience and interpret the local environment
- Sort and classify data and information using drawings or provided tables
- Use tables, simple bar graphs, or other formats to represent data and show simple patterns and trends

Evaluating
- Make simple inferences based on their results and prior knowledge
- Demonstrate an understanding and appreciation of evidence
- Identify some simple environmental implications of their and others' actions

Applying and innovating
- Contribute to care for self, others, school, and neighbourhood through personal or collaborative approaches
- Generate and introduce new or refined ideas when problem solving

Communicating
- Represent and communicate ideas and findings in a variety of ways, such as diagrams and simple reports, using digital technologies as appropriate
- Express and reflect on personal or shared experiences of place

CONTENT | SCIENCE 3

- Biodiversity in the local environment
- Energy is needed for life

CONTENT | SCIENCE 4

- Sensing and responding (humans, other animals, plants)

LESSON 1
Bats are Interesting

Image by Jared Hobbs M.Sc., R.P.Bio.
Photographer / Biologist

BIG QUESTION:
How do I compare a bat?

OBJECTIVE
Students will compare the size of a model bat to themselves, including the weight, height and length. They learn that bat wings are like human hands and that humans are more closely related to bats than humans are to birds. Finally, students play a drum game to learn about how bats adjust their heart rate to save energy.

MATERIALS
- Plastic bat replica (a class set of 10)
- Bat specimens from RBCM
- Two nickels and one dime
- 14 medium-sized paper clips
- Plastic balance
- Measuring tape (a class set of 10)
- Bat Size Worksheet
- Laminated image of a pallid bat
- Drum

LESSON PLAN
Bat size (K–1 & Grades 3–4, 30 min)

1. Hold up and show one of the bat replicas. Explain that biologists use mist nets to capture and study bats in the wild. Once caught, their size is measured to determine the age of young bats (called pups) and provide species identification of adults. Explain that students will study the weight, height/length and wingspan of bats in class today.

2. Bats are small mammals! Show an average-sized Canadian bat from the RBCM mammalogy collection. Students can look at the bat specimens in the box but cannot touch them. Explain that these bats are precious, so we will instead work with bat replicas in the class.

3. Explain that a typical bat such as little brown myotis weighs about 8 grams, which is about the weight of two nickels and a dime, or 14 paper clips. Pass these around so that students can feel how light this is. Then, use a balance to compare the weight of a bat with other objects in the class, such as a stapler, ruler, pen or scissors. Ask students to predict if the bat will be heavier or lighter than the object; would students themselves be heavier or lighter than a bat? Record this data on the **Bat Size Worksheet (pg. 7)**

4. Ask students to find a partner and pick out a bat from the front of the room. Student will measure the height and wingspan of the bat and compare this with the height and arm span of their partner. K–1 students can use non-standard measuring tools (e.g., number of hands or number of pencils), while Grade 3–4 students can use a measuring tape. Older students could be challenged

to record their answers in different units, such as centimetres, metres, inches or feet. Students can also draw a sketch of the bat and themselves. Record this data on the **Bat Size Worksheet (pg. 7)**.

5. Once the class has completed the activity, discuss whether bats are taller or shorter than themselves, and whether bat wings are longer or shorter than their arm spans. With Grades 3–4 students, discuss how the height and arm span of humans are of similar length, whereas the wingspans of bats are much longer than their height. Explain that bats have adaptations, which are features or behaviours that help them to survive in their environment. In general, bats are small and light so that they can fly!

Bat wing (K–1 & Grades 3–4, 20 min)

1. Show a labelled picture of a pallid bat. Read the words written on the picture and invite students to touch parts of their own body as they read the labels together as a class.

2. What do students notice about the bat's wing? The bones of the arm, hand and fingers are stretched out to make a wing. These similarities help scientists understand that bats and humans are more closely related to each other than birds and humans. While bats and birds both fly, scientists believe that these behaviours evolved separately (called convergent evolution). Bats and humans are mammals, whereas birds belong to a class called Aves. Specifically, bats belong to an order of mammals called Chiroptera, meaning "hand-wing" in Greek ("chiro" + "ptera").

3. Let's visualize what a human hand would look like if it were stretched out like a bat's wing. Invite a student volunteer to come to the front and trace the outline of their fingers on a whiteboard to match that of the bat picture. Then, elongate the forearm, second finger, third finger, fourth finger and fifth finger to show how a bat gets its long bones. The thumb is the only finger that remains small; the claws on the thumb help the bat to move around, climb and groom themselves.

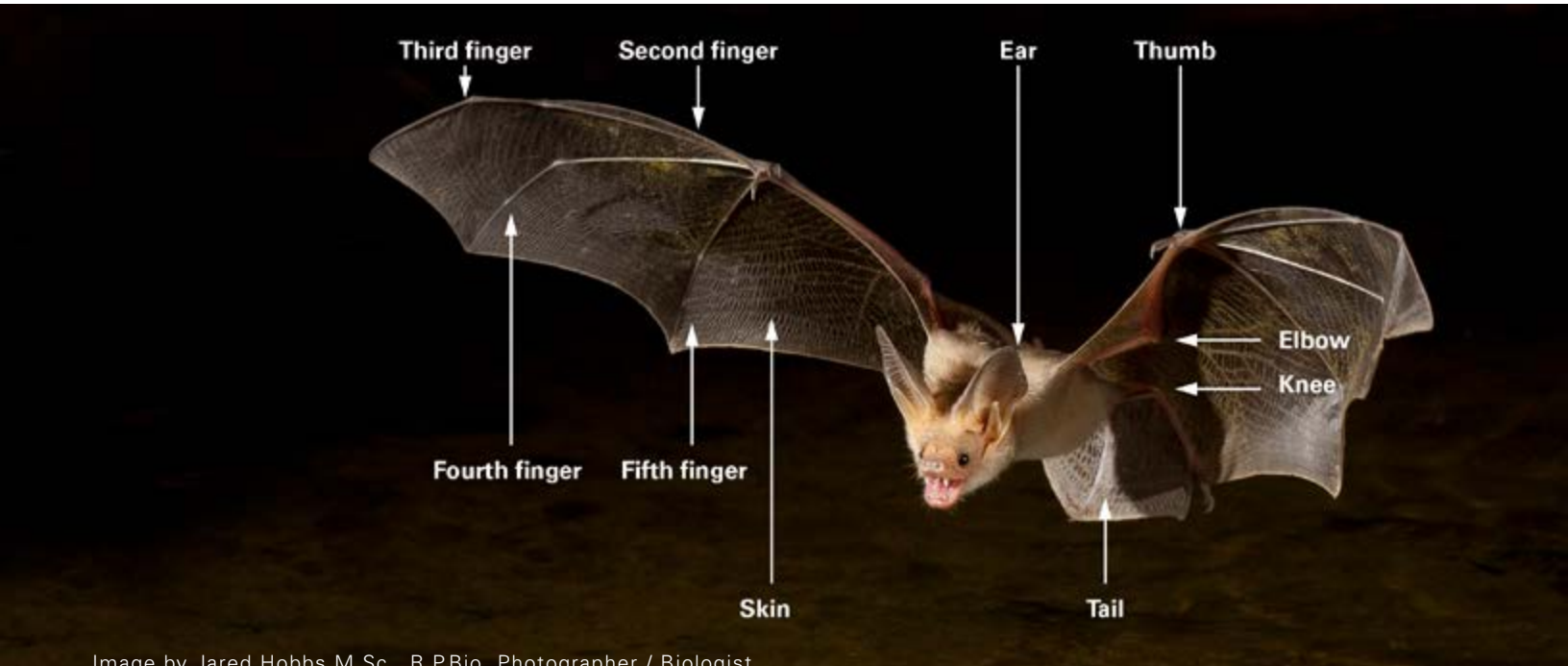


Image by Jared Hobbs M.Sc., R.P.Bio. Photographer / Biologist

Bat heart rate (K–1, 20 min)

1. Turn off the lights and sit in a circle on the floor. Ask students to put their hands on their chest to see if they can feel their heartbeat. The heart rate of bats and humans change based on the intensity of the activity (e.g., exercise). However, bats have a much wider range of heart rate and change their rate in response to the external environment (e.g., cold weather).

2. Explain to students that they will now become bats! Beat the drum and ask students to fly around the class and flap their arms (wings) to the beat of the drum (note: bats' wings do not actually flap at the same rate as their heart in the real world). When the drum slows down, students should move slowly to match the beat. Repeat this several times, changing the beat of the drum each time.

3. At the end, beat the drum as slowly as possible. Explain that winter is coming and that bats will soon enter a state of hibernation. Invite students to fold their arms (wings) in front of their chest and huddle around the teacher as quietly as possible, bending over at the waist if they like to be upside down like a bat in hibernation.

4. Explain to students that they have just demonstrated a condition called torpor. Bats are small mammals that are poorly insulated and lose heat quickly. Since maintaining a constant body temperature uses a lot of energy, bats enter torpor to slow down their metabolism and reduce their body temperature and heart rate when external environments are unfavourable. Bats can be in torpor for a few hours during the day on a cold day or a few months during winter hibernation.

5. Ask students to find their pulse on their wrist or neck and count the number of beats for 60 seconds. What is their heart rate? A typical preschooler would have a resting heart rate of about 80 to 140 beats per minute. Bats have a much wider range: their heart rates could be as high as 1000 beats per minute during flight or as low as 10 beats per minute during hibernation!

How Do I Compare to a Bat?

BAT	**ME**
Weight:	Weight:
Height:	Height:
Wingspan:	Arm span:
Picture:	Picture:

IN SUMMARY: PICK ONE!

Bats are *heavier* or *lighter* than me.

Bats are *taller* or *shorter* than me.

Bats have a *longer* or *shorter* arm span than me.

LESSON 2
Bats are Important

Image by Jared Hobbs M.Sc., R.P.Bio.
Photographer / Biologist

BIG QUESTION:
How are bats important to our society and environment?

OBJECTIVE
As creatures of the night, bats get a bad reputation. Other nocturnal animals like owls are also associated with spooky Halloween and haunted houses. Mostly these are imagined stories with no shortage of scary, incorrect information. Using true/false cards, students learn about how bats are keystone species and provide critical benefits to our society and environment, such as eating insect pests of humans, crops and forests. In the bat and moth game, students learn about how bats use echolocation to catch insects in the dark. In the follow-up slinky demonstration, students investigate how sound waves travel in the atmosphere.

MATERIALS
- True/false cards
- Bats of British Columbia handbook
- Blindfolds (a class set of five)
- Slinky
- Computer (to play videos)

LESSON PLAN
Bat facts and myths (K–1 & Grades 3–4, 30 min)

1. Learn how to say "bat" using a First Nations language. For example, the Syilx Okanagan people have two words for bats: **t'ənt̓anwiya** (referring to the way that bats fly) and **saṗyaxn̓** (meaning skin/hide and wing). The Coast Salish people call bats **slhul'p'ul'exun'** (meaning floppy wings) in the **Hul'q'umi'num** language; here is how to pronounce it. What is the word for bat where you live?

2. Show true/false cards to learn more about fun facts and myths related to bats. Invite students to guess whether they think the statement is true or false; then, flip over the card to reveal the answer. This could be played like a game by dividing the class into groups and tallying the number of correct guesses.

3. Show more images of bats on the RBCM's Learning Portal. Learn about the 15 different species of bats in BC, which are referenced in the museum handbook, Bats of British Columbia. Discuss that all bats in BC are insectivores. Invite students to explore what else bats eat in other parts of the world and what else they would like to know about bats.

Bat and moth game (Grades 3–4, 30 min)

1. Explain to students that bats use echolocation to communicate, navigate and hunt in the dark. Echolocation is the process of using sound to locate the presence of objects such as prey. Students will play a bat and moth game to better understand how this works.

2. Choose an open space and ask students to stand in a large circle. Two students will be in the middle of the circle; one will be a bat (blindfolded) and the other will be a moth (note: bats are not actually blind, but they rely on sound to hunt at night). The rest of the students will be trees in a forest. The goal of the game is for the bat to catch the moth using echolocation, like in the familiar kids' game Marco Polo.

3. Allow a few seconds for the moth to move away from the bat. Once the game starts, the bat will say "bat" and the moth must respond by saying "moth." If the bat gets too close to the edge of the circle, the trees can respond by saying "tree." Over time, the bat should find their way to the moth, as the sound will be heard more loudly the closer the bat is to the moth. Bats can also say "bat" more frequently the closer it is to the moth in order to narrow the target area for capture. Play several rounds of this game, adding to the number of bats and/or moths in the circle each time.

4. At the end of the game, explain how bats and moths are predators and prey in a food chain; as bats eat moths (and other insects), energy is passed from one level to another. However, moths have evolved adaptations to evade bats. Did students notice that moths in the game moved in different ways to avoid bats? In the real world, different moths also show acrobatic displays in the night sky or even have sound-absorbing wings to make them invisible to bats!

5. Discuss the science of echolocation. What allowed bats to catch the moths? Students should be able to explain how bats produce sound, which is then received as an echo when it bounces off the moth. Many bats have big ears, which is another adaptation to hear the fluttering sound of insects. Play this video on spotted bats (also in French) to summarize what students learned.

Sound waves demonstration (Grades 3–4, 20 min)

1. Students will next learn about how sound moves through the air. Explain that sound is caused by the vibration of air particles, which creates a path of waves. Bats typically produce echolocation calls at a high frequency beyond the hearing range of humans but can be heard when they are slowed down like this.

2. Get two student volunteers and have them stretch out a slinky on the floor. Ask students to predict what happens if a volunteer pushes one end of the slinky. Students should see the energy travelling through the slinky, like how sound waves move through air. The two volunteers can push the slinky back and forth to demonstrate the movement of sound waves in both directions.

3. Now ask the volunteers to vary the force of the push. A strong push causes the sound waves to travel quickly, while a light push causes the waves to travel slowly. This is a demonstration of loud versus quiet sound; the force of the push can change the pressure wave that hits our ears, thus causing us to perceive some sounds as loud or quiet.

4. What happens when the source of the sound and the receiver are close together? This time, have one volunteer be the bat and the other be a moth on either end of the slinky. Ask the bat to move closer to the moth while pushing and pulling the slinky. Students should observe that the waves compress and travel more quickly the closer the bat and moth are to each other. This explains why a sound can be heard louder the closer you are to the source, and why bats can better identify the location of moths the closer they are to one another.

5. Summarize what students learned by showing SciShow Kids videos on What is sound? and How do bats see with sound?

Image by Jared Hobbs M.Sc., R.P.Bio. Photographer / Biologist

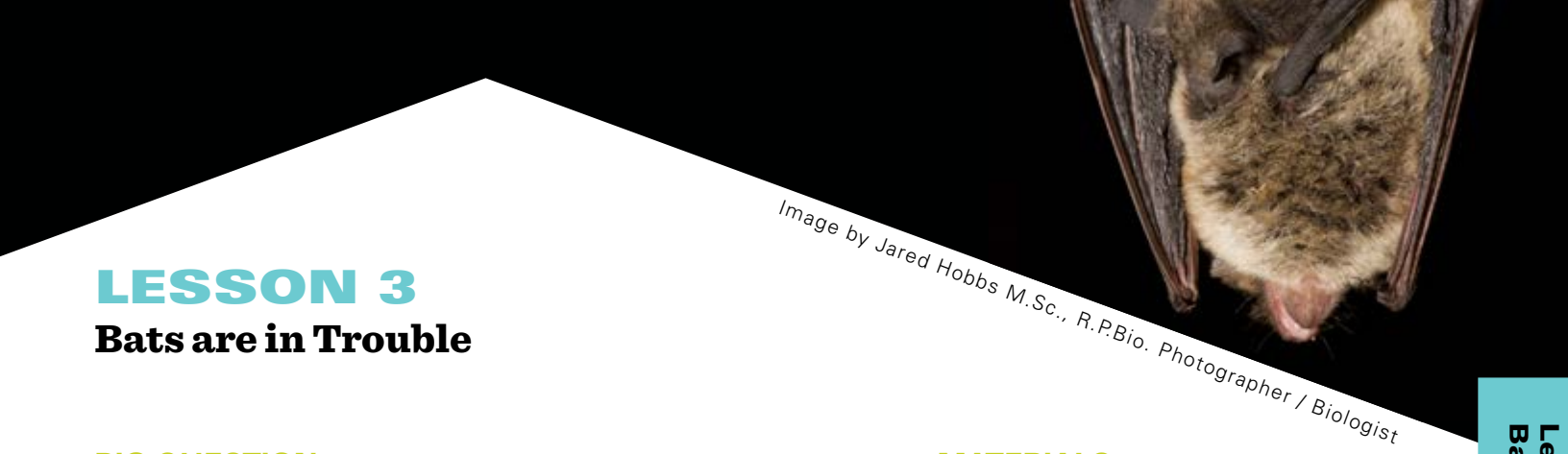


Image by Jared Hobbs M.Sc., R.P.Bio. Photographer / Biologist

LESSON 3
Bats are in Trouble

BIG QUESTION:
How are bats threatened in BC?

OBJECTIVE
Students will learn about two major threats to bats in BC: habitat loss (K–1) and white-nose syndrome (Grades 3–4). Students will go on a forest walk with hand-bats to learn about how bats depend on trees for summer roosts. Older students will learn about how a fungal disease called white-nose syndrome has decimated the bat population in North America and how this disease spreads through direct and indirect contact.

MATERIALS
- Tree model
- Laminated hand-bats (a class set of 25). Children put their fingers through the holes to wear the bats on their hand.
- Blank paper
- Coloured pencils and markers
- Computer (to play simulation)
- Index cards
- WNS Spread Data Worksheet
- 4 dice
- Bag of white tokens

LESSON PLAN
Habitat loss (K–1, 45 min)

1. Select a forested area near your school to go on a daytime bat walks (indoor option: use a tree model instead). Distribute the hand-bats to students and demonstrate how students can put their fingers through the two holes. Students may enjoy walking with the bats attached to their hands, making them flap and flutter as they move along in the program.

2. On the forest walk, explain how bats in BC often roost in trees in the summertime to raise their babies. Different bats roost in different coniferous or deciduous trees such as western white pine or trembling aspen. Bats like to roost in tree holes, cracks, and crevices under bark; see if students can find old tree hollows, cavities made by woodpeckers or trees with peeling bark (e.g., those damaged by lightning).

3. Once the group finds a tree with a large hole, invite students to estimate how many bats can fit in it. Explain how bats are small and poorly insulated, and female bats like to roost together in colonies to provide warmth for them and their pups. Demonstrate how students can fold the wings on their hand-bats to cover the bat's body during roosting. They can make a more accurate estimate this way, as more bats should fit in the hole.

4. Invite students to find a spot to sit by their favourite tree. Allow them to quietly observe the forest and imagine bats living in their tree hole. Use paper, coloured pencils and markers to draw a picture of this experience in their local environment.

5. Lastly, discuss how habitat loss affects bats. Can students predict what happens if bats lose their favourite tree to roost in? Of the 15 species of bats in BC, three are currently endangered or threatened in Canada, and six are blue- or red-listed in BC. For example, northern myotis are threatened by commercial forest harvesting, and pallid bats are losing their habitat to urban development in the Okanagan. The best way to help bats in BC is to help protect their native habitat.

Introduction to white-nose syndrome (Grades 3–4, 10 min)

1. Explain that another major threat to bats is white-nose syndrome (WNS). The disease is caused by a fungus that thrives in dark, moist environments like caves. The fungus can show up as a white fuzz on bats' noses and wings in winter, like what happens when food gets mouldy. The fungus infects bats during hibernation, causing them to wake up in the winter and use up the fat reserves that they need to survive in the cold.

2. Show the spread map of WNS here. Play the simulation to show how WNS was first detected in New York in 2006 and gradually moved across the western US and Canada. In eastern Canada, bats like little brown myotis have been severely affected by WNS, causing them to become endangered. In April 2023, biologists detected the first evidence of WNS in bat guano near Grand Forks, BC. There is great concern that WNS will soon cause a devasting impact on bats in BC.

3. Why does WNS spread quickly? Brainstorm a list of how diseases spread, such as how one can get a cold or a flu. Most of the ideas can be grouped into direct contact (e.g., touching someone who has a cold) or indirect contact (e.g., touching a doorknob that someone with a cold has touched).

WNS direct contact simulation (Grades 3–4, 30 min)

1. Play a high-five games (adapted from National Geographic) to demonstrate the direct transmission of WNS. Give each student an index card and assign a unique number to each student. One student in the class is a bat that has been infected with WNS, but we don't know who that is yet.

2. Play music and ask students to fly around the class like bats. Each time the music stops, they should high-five the student closest to them and record their number on their index card.

3. After students have three numbers recorded on their card, ask them to sit down. Roll two dice (or more as needed for the number of students in your class) and add the numbers to reveal the bat that was infected. Every student who has high-fived this bat is also now infected with WNS. Record the total number of infected bats on Table 1 of the **WNS Spread Data Worksheet (pg. 16)**

4. Repeat this game two more times. Increase the number of initially infected bats each round; that is, roll the dice twice in round 2 to reveal two infected bats and thrice in round 3 to reveal three infected bats in the class. See how the initial number of infected bats impacts the total number of infected bats at the end of the game. Graph this data as a bar graph on the WNS Spread Data Worksheet.

5. Explain how WNS often spreads this way through bat-to-bat contact. Because some bats like to hibernate in large colonies, WNS can spread quickly both within and between species of bats. However, BC bats that live in the west of the Rocky Mountains like to hibernate in small groups or singly, which may help to reduce transmission in BC compared to the east.

WNS indirect contact simulation (Grades 3–4, 30 min)

1. Play a modified musical chairs game. Ask students to arrange their chairs in a circle. Select one student to be a bat that is infected with WNS and give this student a bag of white tokens.

2. Play music and ask students to walk around in a circle. When the music stops, students must sit on the chair closest to them. The infected student will leave behind a token under their chair. Every student who sits on this chair as the game continues will be eliminated from the game (note: the newly infected student will be eliminated, but the chair will remain in the circle). Over time, the original infected student will move around and leave tokens on many chairs, eventually wiping out the whole population.

3. Play the game again. This time, ask a student volunteer to count the number of bats that are affected on Table 2 of the WNS Spread Data Worksheet. Record as many rounds as necessary until most of the bats are eliminated. Graph this data.

4. Discuss how this is an example of an indirect disease transmission. Bats that come in contact with surfaces that have fungal spores can also become infected. This contributes to the rapid spread of WNS. Humans, too, can disperse fungal spores indirectly through clothes, shoes or outdoor gear. To prevent the further spread of WNS, some BC parks like Horne Lake Caves Provincial Park ask visitors to walk through a bio-cleaning station before walking through the caves.

Image by Jared Hobbs M.Sc., R.P.Bio. Photographer / Biologist

WNS Spread Data Worksheet

TABLE 1:
Number of bats affected by **direct contact** between bats

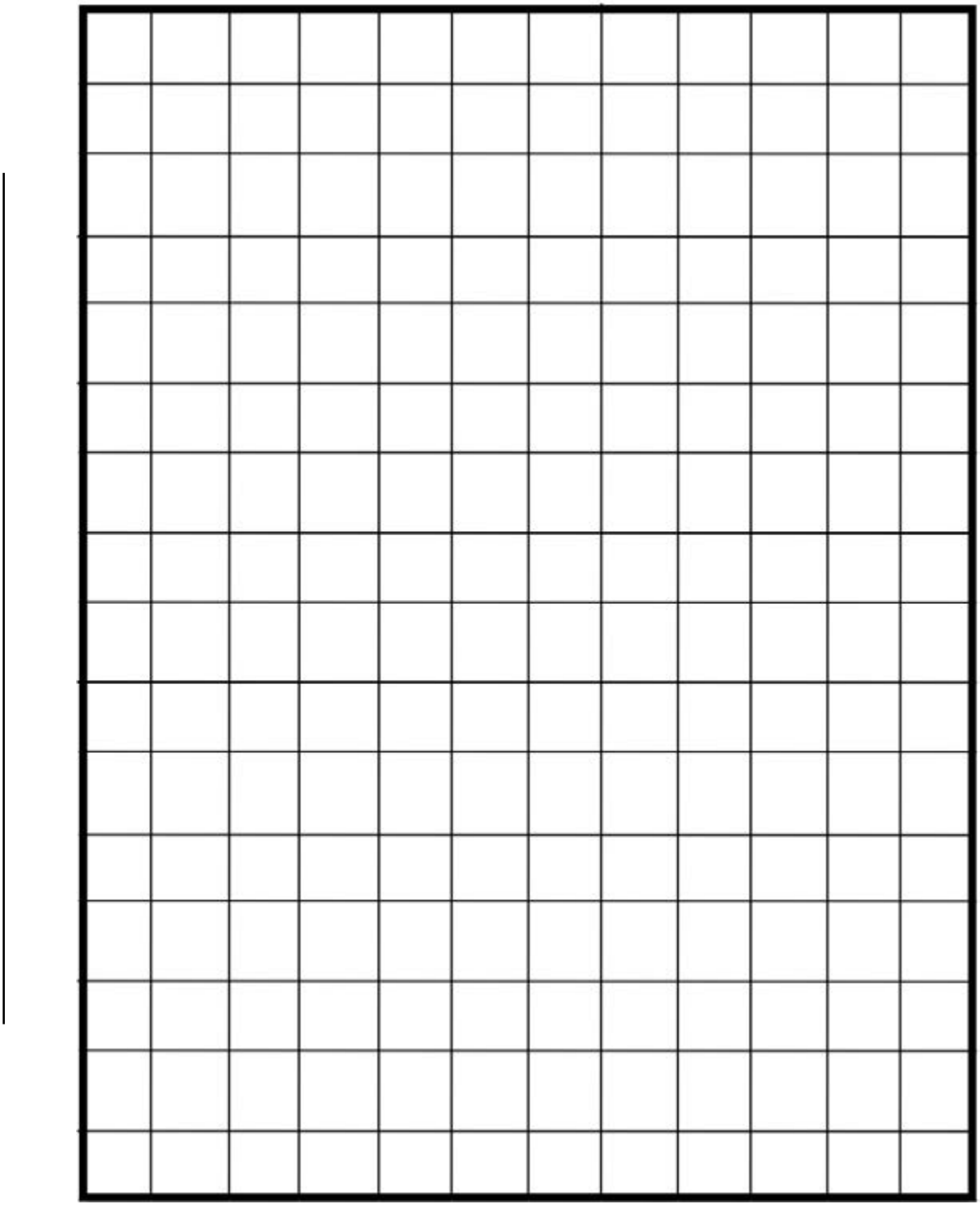
	Total number of affected bats
1 infected bat	
2 infected bat	
2 infected bat	

TABLE 2:
Number of bats affected by **indirect contact** between bats

	Total number of affected bats
Round 1	
Round 2	
Round 3	
Round 4	
Round 5	
Round 6	
Round 7	
Round 8	

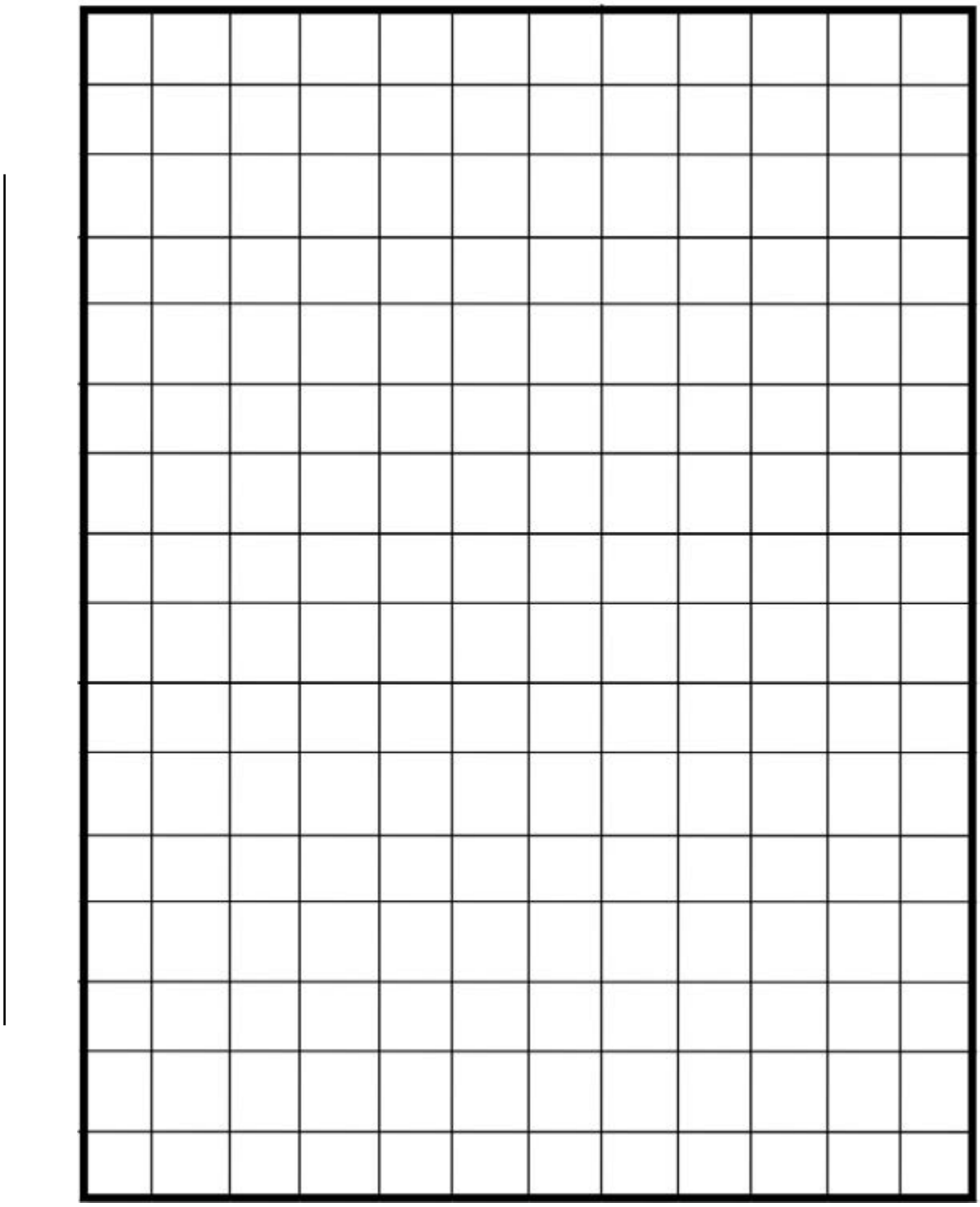
WNS Spread Data Worksheet

Graph 1 Title: _____



WNS Spread Data Worksheet

Graph 2 Title: _____



LESSON 4
Bats Need Our Help

Image by Jared Hobbs M.Sc., R.P.Bio. Photographer / Biologist

BIG QUESTION:
What can we do to save bats?

OBJECTIVE
Students learn about how they can take action to protect bats. Citizen science projects like the BC Annual Bat Count invite community members to track bat populations in their neighbourhood. Use what students learned in Lessons 1–3 to further brainstorm how they could take action in their local community such as by hosting a bat education booth, organizing bat week events or making bat-friendly gardens.

MATERIALS
- NatureKids Bat ID cards
- BC bat-friendly community guide

LESSON PLAN
Citizen science (Grades 3–4)

1. Explain that citizen science is a collaboration between scientists and community members to collect and share data on a science project. Anyone can become a citizen scientist, from amateur bat enthusiasts to young budding scientists!

2. Learn about a citizen science project called the BC Annual Bat Count. The project helps monitor populations of bats in known summer roosts such as abandoned houses, barns or churches. Participants meet a few times in the summer at various locations to count the number of bats flying in and out of their roosts after sunset. Check out the BC community bat network to learn when and where organized bat counts occur in your local region. Alternatively, if you or your

students know where a roost is, counts could be done there individually. Note that counts are done in the summer (June–August) so some counts will fall outside of the school year. Students could alternatively watch this video in the class and practise counting bats!

3. Make sure to follow the instructions on how to count bats and send your data through the BC Annual Bat Count website. Simplified kid-friendly versions of these instructions could be found on NatureKids' website. Also use NatureKids' bat ID cards to familiarize yourself with the types of bats in your area.

Be a bat champion (Grades K–1 & 3–4)

As a class, brainstorm ways to help bats in your local community. There are many ideas in the BC bat-friendly community guide. Some other starting ideas include:

- Get involved in Bat Week, an international celebration of bats in October. This happens just before Halloween, so it could be paired with some Halloween events at your school. For example, students can prepare a presentation or create an education booth to debunk common bat myths!

- Make a bat mural showing the diversity of 15 bat species in BC.

- Make a bat-friendly garden. Planting native plants increases the biodiversity of the ecosystem, attracting insects that bats like to eat. Remove invasive species such as common burdock or himalayan blackberry, as bats' wings can get caught in them.

- Build a bat box with an adult. Note: only some bat species are known to use artificial bat boxes, and most bats in BC use natural habitats. Explore different box designs and carefully consider the placement of the box in your area.

- Organize a bat food sale to raise awareness about different bat-dependent foods like avocados or mangoes. See the bat cookbook for ideas.

- Clean up a body of water at or near your school. Bats need a calm body of water (e.g., lake or pond) to drink, as fast-moving water can make drinking challenging.

Image by Jared Hobbs M.Sc., R.P.Bio. Photographer / Biologist

Additional Resources

- Learn more about the 15 bat species found in BC using the Royal BC Museum's Learning Portal.
- Visit Community Bat Programs of BC to learn about bat research and conservation in your local community. Check out their BC bat edu-kit guide, which includes 35 hands-on activities and a kit that can be rented out in the Okanagan.
- Read about the conservation status of 15 bat species in BC through the Wildlife Conservation Society.
- Read about the nine species of bats found on Vancouver Island with Habitat Acquisition Trust, including what you should do if you find a bat or come in contact with one.
- Borrow a bat pack from the Fraser Valley Regional Library, which includes an echo meter detector device to hear bat sounds. Bat packs are now also available in Squamish, Penticton and Thompson-Nicola Regional Libraries, and the Kootenay Library Federation network!
- Watch videos made by the Bat Squad, a four-part webcast series hosted by kids.
- Watch "Batty Bat" by Count Dracula on Sesame Street.
- Listen to more bat calls from Yellowstone National Park with Acoustic Atlas.
- Read the Bat Brigade comic to learn about threats to bat populations.