



in the Classroom

Curriculum-linked activities that bring students' love of animals to life!



White-nose Wipeout

An interactive game that will help teach students about the importance of bats and the devastating impacts of White-nose Syndrome on their populations.



White-nose Wipeout: Classroom Activity

White-nose Syndrome is a disease that has had a serious impact on North American bat populations since it was first discovered in 2006. It is caused by a fungus, *Pseudogymnoascus destructans*, that spreads rapidly between bats and has already killed millions of these furry flying mammals – once a colony is infected, less than 10% of its members are likely to survive! In this Classroom Activity, students will learn more about how White-nose Syndrome affects bats and will participate in an interactive game to demonstrate the rapid spread of this fatal fungus. This activity and follow-up discussion will take between 30–45 minutes and should take place in a large open playing area, like a gymnasium or a classroom with its desks cleared out.

✂ Materials

• Access to a gymnasium or other large open space • Tape • Bat cards – one per student (provided) • Teacher's Guide (provided) • Student Worksheet (provided)

📖 Instructions

1. Before beginning the classroom activity, lead a classroom discussion on the key concepts outlined in the Teacher's Guide (mammals, bats, White-nose Syndrome). Students should understand these basic ideas since they provide the context for the activity below.
2. Choose your playing area and distribute one bat card and a piece of tape to each student. All students will begin the game as healthy bats and should stick their bat cards on their shirts with the "I'm a healthy bat!" side visible.
3. Give students 30 seconds to run around and select a spot to hibernate for the winter. Tell students to choose their spots in groups of 3-4 (to simulate bats roosting in clusters), and explain that they can select any spot in the gym (which serves as a cave, or hibernacula) they'd like for their hibernation.
4. In the first round of the game, the students will begin their hibernation and should close their eyes and remain standing for the duration of the activity to pretend they're hibernating. The teacher will play as a bat that becomes infected with White-nose Syndrome. Announce to students that now that you've been infected by the fungus and have woken from your hibernation, you're itchy, hungry, and on the hunt for insects!

Did you know?

Because they hunt at night, bats don't have many natural predators, but they should watch out for weasels! This group of animals, which includes Pine Martens like Earth Rangers Animal Ambassador Timber, are known to prey on anything they can catch – which often includes bats!



Activity at a Glance

Grade level: 5 or 6

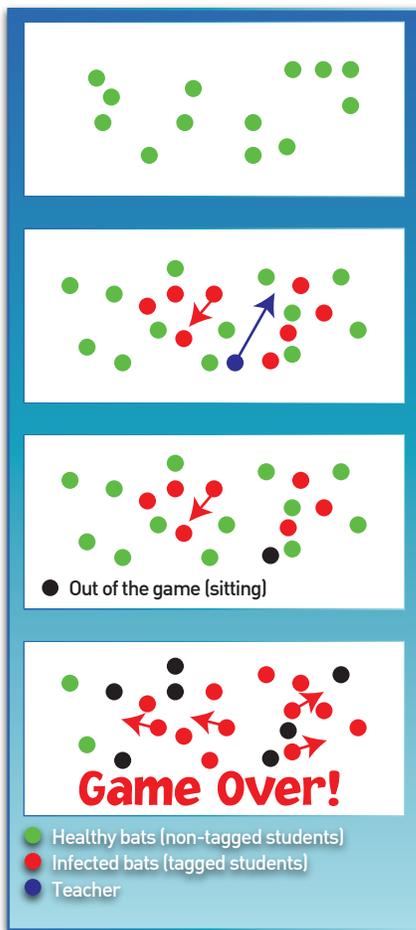
Overall objectives: Investigate the spread of White-nose Syndrome and learn how it affects bat populations across North America

Key concepts: mammals, bats, White-nose Syndrome- see Teacher's Guide for more information

By participating in the White-nose Wipeout Classroom Activity, students will meet the following curriculum expectations:

1. Investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
2. Assess human impacts on biodiversity, and identify ways of preserving biodiversity





5. Tell students that you'll now take 10 steps on your way out of the cave to look for food and will infect and tag every student that you pass with White-nose Syndrome. Students that are tagged will open their eyes and flip their bat card over to signify that they've been infected.

*note: choose a starting point such that you are 10 steps away from one student. After the first round, only one student should be tagged, representing one infected bat.

6. In the second round of the game, tell students that you and the infected bat you tagged have just returned to the cave following an unsuccessful trip to find insects outside. You're ready to rejoin a cluster to resume your hibernation, but you'll spread the fungus to any bats you touch. You and the tagged student will take 10 steps towards 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.

*note: depending on the size of the space selected, the number of moves taken each round can be modified.

7. Sadly, after two rounds of moves, the effects of White-nose Syndrome are devastating and you have fallen victim to the fungal disease. You will now sit down and remove your bat tag.

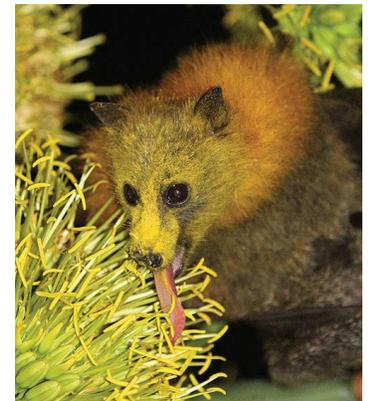
8. Tagged students will continue to spread White-nose Syndrome by taking 10 steps towards a bat colony they can hibernate with. Tell all students that once tagged they have only two rounds of moves before they'll succumb to White-nose Syndrome, at which point they'll remove their bat tags and sit on the ground.

9. The game continues until roughly 90% of the students have been tagged. When this occurs, explain to students that most of their colonies have been entirely wiped out over the course of just one winter hibernation, simulating what occurs in real hibernacula that become infected with White-nose Syndrome.

Wrap-up and Discussion

Now that students understand how (and how quickly!) White-nose Syndrome spreads through bat colonies, facilitate a discussion about the importance of bats and the initiatives currently underway to help stop the spread of the infection. Have students share any experiences they might have had with bats, and ask why they think bats are important. Important points include:

- **Bats are pollinators:** Pollination by bats occurs mostly in tropical climates by bats that feed on nectar, but also occurs when bats pick up pollen while feeding on insects living in or around flowers. Bats are attracted to large flowers and are important pollinators of over 500 plant species, including bananas, cocoa, peaches, and mangoesⁱⁱ.
- **Bats are effective pest control:** One bat can consume between 30-50% of its body weight in one feeding – over the course of a year, this can add up to over 200,000 mosquitoesⁱⁱⁱ! It is estimated that bats provide upwards of \$3.7 billion in “pest-control services” to the agriculture industry in the United States alone, and with some colonies losing over 90% of their populations after infection with White-nose Syndrome, this can have significant economic impacts^{iv}.
- **Bats are important for seed dispersal:** Fruit bats live in warm climates and, as their name suggests, feed primarily on fruit. Contrary to popular belief however the bats don't always consume the entire fruit; instead, they use their teeth to pierce the skin and drink the nectar^v. By doing this, the bats leave the seeds intact and exposed, ready to grow or be eaten by another animal. Bats that do consume the entire fruit are effective long-distance seed dispersers and will either excrete small seeds after digestion^{vi} or spit out larger ones as they fly^{vii}.
- **Bats are an indicator species:** Bats have a long lifespan and low reproductive rate, making them slow to adapt to changes in their environments and, as such, easily affected by disturbances^{viii}. Because they are so numerous and diverse in their habitat use and food preferences, they are effective indicators of ecosystem health across a number of different systems^{ix}. They are also easy to monitor and decreases in bat populations can indicate declines in insect populations, changes in plant populations, and loss of habitat (among others)^x.





Did you know?

Bald eagles, like Earth Rangers Animal Ambassador Koho, faced a threat just as scary and widespread as the White-nose Syndrome bats are currently facing. The use of DDT, a common pesticide, was destroying bald eagle eggs! Thanks to lots of research and public support, DDT was banned and eagle populations have since recovered.

Current Conservation Efforts

While there are no known cures for White-nose Syndrome, scientists are working hard to try and stop its spread. Research into its distribution and how it affects the bat colonies it infects is a critical first step, and to complement this work scientists are trying to develop artificial bat habitats that can be properly cleaned after the hibernation period to remove the *P. destructans* fungus.

- In Canada, the Ontario Ministry of Natural Resources and Forestry's (OMNRF) White-nose Syndrome Response Plan focuses on communicating critical information to increase public awareness about the issue, its significance, and its prevention. The OMNRF is working to identify sites that have been infected and is posting notices at these site entrances restricting their access and detailing the decontamination protocol that should be used by all visitors. They have also established public reporting services to help track the spread of the disease^{xi} and are working to develop artificial, cleanable homes that can be used by roosting bats in areas with known bat populations^{xii}.
- In the United States, The Nature Conservancy spent \$300,000 to build an artificial bat cave in Tennessee that can be cleaned to remove all fungus once the bats have left in the spring. The cave was constructed beside an existing bat cave and buried under a hill of dirt to look as natural as possible, and scientists estimate over 100,000 bats could use the habitat for a safe and fungus-free hibernation. Only 6 months after its completion, The Nature Conservancy reported visits by several species of bats^{xiii}! Students can see bat scientist and project director Cory Holliday discuss the initiative here:

http://cdnapi.kaltura.com/index.php/extwidget/preview/partner_id/1012331/uiconf_id/24075381/entry_id/0_6c1zxe7/embed/dynamic.

Humans can spread White-nose Syndrome by carrying the fungus on their shoes and clothing after visiting contaminated caves, trails, abandoned buildings (used as roosting sites and hibernacula), and mines. Avoiding these locations and thoroughly decontaminating clothing and equipment is important, and reporting bat sightings and potentially infected bats or caves is critical^{xiv}.



Take it to the Next Level (optional)

Your class can build your own bat habitat by creating a bat box out of wood! Students can help put together a bat box which provides critical roosting habitats for bats and protection from predators.

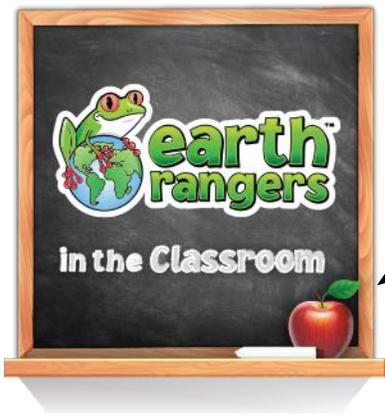
Find more instructions here: http://cwf-fcf.org/assets/pdf/en/Bat_House_Instructions.pdf.



Did you know?

Like bats, Earth Rangers Animal Ambassador Sonic the Barn Owl also hunts in the dark, but insects don't appeal to him – he prefers to feast on mice and rats!





White-nose Wipeout

Teacher's Activity Guide

Use this guide to facilitate a discussion on the Key Concepts below prior to leading the classroom activity.

Key Concept One: Mammals and Bats | Key Concept Two: White-nose Syndrome | Game quick tips | Bat cards

Generously supported by:



TD Friends of the Environment Foundation

Key Concept One: Mammals and Bats

Mammals are a group of animals that share a number of common features, including:

- Endothermy: mammals are warm-blooded, which means they're able to generate and maintain their own body heat. This is in contrast to ectotherms (like lizards and turtles) that are cold-blooded and rely on ambient heat sources to raise and control their body temperature^{xxv}.
- Advanced brain development: the mammalian brain contains a special region called the neocortex. This region is not found in any other group of animals and helps with language, motor skills, sensory perception, and other cognitive functions^{xxvi}.
- Vertebrae: all mammals have a spine or backbone (vertebral backbone). Although there are over 5,000 species of mammals of all shapes and sizes, all mammals (with the exception of two sloth species and the manatee) have exactly seven vertebrae in their necks^{xxvii}.
- Body hair or fur: because they are warm-blooded, all mammals have hair (or fur) to help prevent heat loss by creating an added layer of insulation. Marine mammals also have hair; dolphins are born with a small patch above their nose that eventually wears off, while some whales have hair-like fibers that they use to feed^{xxix}.

Bats are a unique group of mammals made up of hundreds of species that are found all over the world, covering every continent except Antarctica^{xx}. They are the only true flying mammal (in contrast to the sugar glider and flying squirrel, which simply glide between tree branches), and their "wings" are in fact four long fingers covered with a thin membrane^{xxi}. Most bats feed primarily on insects and hunt at night, using echolocation to find their prey^{xxii}. Hunting in the dark might seem ineffective, but it's estimated that one bat can consume up to 50% of its own body weight in insects in just one night^{xxiii}!

Bats typically live in colonies and nest in old buildings, caves, or trees^{xxiv}. These nesting sites are called roosts, and the roosts bats occupy when they hibernate in the winter are called hibernacula. Hibernacula provide protection from the harsh weather and from predators, which is important as bats are vulnerable to these elements while they are dormant for the 3-6 months until spring^{xxv}. Bats hibernate in the winter when the insects they eat become scarce, allowing them to conserve their energy and survive on the stored fat reserves they accumulated when food was abundant in the summer months^{xxvi}.

Key Concept Two: White-nose Syndrome

White-nose Syndrome is caused by a fungus, *Pseudogymnoascus destructans*, which thrives in cold, damp locations (like hibernacula). It is spread via direct contact between infected bats but also spreads through airborne spores and is suspected to "hitchhike" on the clothes and shoes of humans who travel through hibernacula^{xxvii}.

Once infected, a hibernating bat will develop the characteristic patch of fuzzy white fungus on its nose that is responsible for giving White-nose Syndrome its name. As the fungus spreads to the bat's ears and wings, it causes it to wake from hibernation and eventually starve to death, having depleted its fat reserves and now unable to find food in the middle of the winter^{xxviii}. White-nose Syndrome can also cause bats' thin wings to lose water and become brittle, causing tears and lesions that can affect their ability to fly^{xxix}.

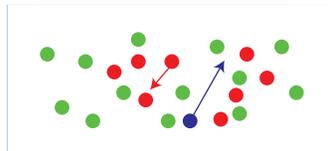
In Ontario, White-nose Syndrome was first identified in 2010, and has also been found in 25 states and four additional provinces^{xxx}. It has affected seven bat species to date, and in Canada three of these species are now listed as endangered^{xxxi}. A bat's average lifespan is 20 years, but because they produce only one pup each year, populations affected by White-nose Syndrome decline much faster than they recover^{xxxii}.



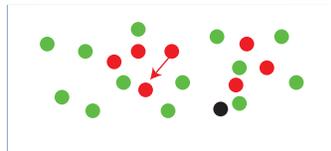
Game Quick Tips



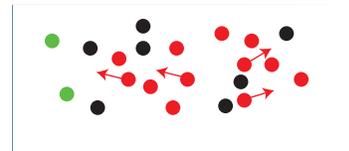
Round One: All students are healthy bats and have 30 seconds to find a place to hibernate.



Round Two: Teacher is infected with White-nose Syndrome and tags one student who becomes an infected bat.



Round Three: Teacher and tagged student (infected bat) take 10 steps towards other bat colonies, tagging every student they pass. Students have two rounds before they succumb to White-nose Syndrome and are out of the game.



Round Four+: Tagged students continue to tag healthy bats and game continues until less than five healthy bats remain.



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!



I'm a healthy bat!

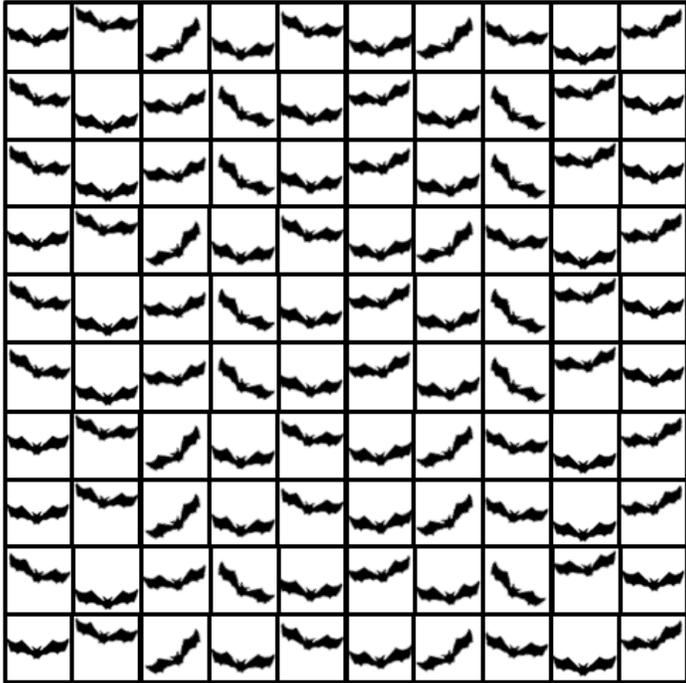


White-nose Wipeout



White-nose Wipeout Student Worksheet

Name: _____



To better visualize the widespread and devastating effects of White-nose Syndrome, simulate its spread through the colony of 100 bats in the grid on the left.

- 1) In the first winter after infection, 90% (9 out of 10) bats in a colony will die. Colour in 90% of your bat colony – how many bats are left?

- 2) After their second winter, another 90% of the surviving bats will not make it. Colour in 90% of the bats left after the first winter – how many bats are left?

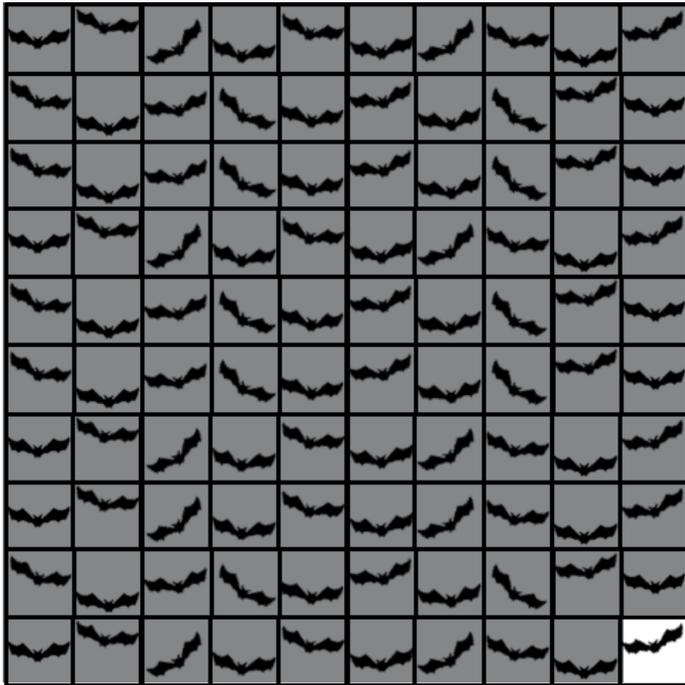
- 3) Explain why you think it's important to help protect bats. Your answer might refer to the importance of bats in the environment, their role in the ecosystem, or even your personal feelings about these unique mammals.



White-nose Wipeout

Worksheet Example Answers

Name: _____



To better visualize the widespread and devastating effects of White-nose Syndrome, simulate its spread through the colony of 100 bats in the grid on the left.

- 1) In the first winter after infection, 90% (9 out of 10) bats in a colony will die. Colour in 90% of your bat colony – how many bats are left?

10

- 2) After their second winter, another 90% of the surviving bats will not make it. Colour in 90% of the bats left after the first winter – how many bats are left?

1

- 3) Explain why you think it's important to help protect bats. Your answer might refer to the importance of bats in the environment, their role in the ecosystem, or even your personal feelings about these unique mammals.

Answers should reference any of the four points covered in the activity discussion:

BATS ARE POLLINATORS, BATS ARE SEED DISPERSERS

BATS CONTROL INSECT POPULATIONS, BATS ARE INDICATOR SPECIES

References and additional resources

i http://www.nwhc.usgs.gov/disease_information/white_nose_syndrome/Battle_for_Bats.pdf
 ii http://www.bats.org.uk/pages/why_bats_matter.html
 iii http://www.batcon.org/pdfs/whitenose/WNS_FAQ.pdf
 iv http://www.biologicaldiversity.org/campaigns/bat_crisis_white_nose_syndrome/pdfs/Boyles2011EconomicofBats.pdf
 v <http://www.batworlds.com/fruit-bat/>
 vi <http://rspsb.royalsocietypublishing.org/content/266/1416/219>
 vii http://www.unalmed.edu.ca/~poboyca/documentos/documentos1/Ecologia_Bosques_tropicales_01_2008/Ligia/Semana_feb_26/FernMuscarellaeta1.2007.pdf
 viii <http://wildlifearticles.co.uk/bat-week-indicator-species/>
 ix <http://web.mit.edu/12.000/www/2006/teams/r4/batsindicator.html>
 x <http://www.int-res.com/articles/esr2009/8/n008p093.pdf>
 xi <http://www.ontario.ca/document/ontarios-white-nose-syndrome-response-plan>
 xii <http://www.earthrangers.com/wildwire/little-brown-bat/>
 xiii <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/tennessee/newsroom/nature-conservancy-confirms-bat-visitors-at-artificial-cave.html>
 xiv <http://docs.ontario.ca/documents/4614-ontario-wns-response-plan-final-april-14-2015.html#document/p8>
 xv <http://minerva.union.edu/litnicw/endo.htm>
 xvi <https://www.sciencedaily.com/terms/neocortex.htm>

xvii http://www.newworldencyclopedia.org/entry/Vertebral_column
 xviii <http://scienceline.ucsb.edu/getkey.php?key=3087>
 xix <http://www.northcoastmmc.org/education/fun-facts/>
 xx http://www.bats.org.uk/pages/bats_of_the_world.html
 xxi <http://animals.howstuffworks.com/mammals/bat1.htm>
 xxii <http://animals.howstuffworks.com/mammals/bat2.htm>
 xxiii <https://www.nwf.org/Wildlife/Wildlife-Library/Mammals/Bats/Little-Brown-Bat.aspx>
 xxiv <https://www.nwf.org/Wildlife/Wildlife-Library/Mammals/Bats/Little-Brown-Bat.aspx>
 xxv http://www.bats.org.uk/pages/a_year_in_the_life_of_a_bat.html
 xxvi <http://www.livescience.com/32227-do-bats-hibernate.html>
 xxvii http://www.nwhc.usgs.gov/disease_information/white_nose_syndrome/Battle_for_Bats.pdf
 xxviii http://www.batcon.org/pdfs/whitenose/WNS_FAQ.pdf
 xxix <http://bmcbiol.biomedcentral.com/articles/10.1186/1741-7007-8-135>
 xxx http://www.nwhc.usgs.gov/disease_information/white_nose_syndrome/index.jsp
 xxxi <https://www.registrelap-sararegistry.gc.ca/default.asp?lang=En&n=0730C653-1>
 xxxii http://www.batcon.org/pdfs/whitenose/WNS_FAQ.pdf

Photos, pg. 2: Courtesy of Andrew Mercer and copyright Duncan Noakes
 Photos, pg. 3: Copyright Jerome Whittingham
 Photos, pg. 4: Courtesy of Ryan von Linden/New York Department of Environmental Conservation (USFWS)