

KEY UNDERSTANDING:

The Bracken Cave bat colony uses complex adaptations and strategies to allow 20 million bats to quickly and safely leave the cave and access food every night.

NGSS CONNECTION:

MS-LS1-4, MS-LS1-8, MS-LS2-1, MS-LS2-2

**MATERIALS:**

- Orange cones
- Small items such as scarves, balls, etc. (to represent insects); enough for 3x the number of participants
- Video, bats leaving Bracken cave
- Feeding buzz image/spectrogram
- Stopwatch/timer
- Optional: scarves to act as blindfolds

Summary

The facilitator sets cones to mimic a cave-like funnel, and students are directed to leave the funnel and gather as many 'insects' as they can. Students then engage with bat content regarding adaptations and strategies related to living in colonies, including watching a video of bats leaving Bracken Cave, and study graphics showing echolocation calls. Students are directed to then try the exercise again using adaptive strategies. Was the group overall more successful the second time?

Setup

- Set orange cones to create a path with a bottleneck/funnel, and scatter 'insect' representatives around the area outside the funnel.
- Computer/TV/projector for watching videos

Script

Today we're going to be exploring information about bats, but before we do we're going to run an experiment. I'd like the group to gather here in the wide part of this funnel. Your task, as a group, is to get everyone safely through the funnel and collectively gather as many of the items as possible. However, we have a few guidelines;

1. For safety, you must walk - no running.
2. Do your best to avoid bumping into any objects or other participants
3. Your eyes must be closed the whole time!

Time group for 10-20 seconds as they attempt to get through the funnel and gather insect items. Then, guide the group through an activity review.

Time's up! How did that go?

- As a group, did we collect all the items, or were there any left over?
- Sit down if;
 - » You picked up only one item or less
 - » If you bumped into anyone else during this game
 - » If you bumped into any objects during the game, including the funnel cones

This exercise showed us what the Mexican Freetail Bats living in Bracken Cave are up against. In our funnel exercise, those of us left standing at the end represented bats that successfully flew out of their cave without mid-air collisions, and went on to collect enough insects to survive. Those of us that were seated were not successful. How many of us are left standing?

Every night, 20 million bats leave the entrance to Bracken Cave in search of insects, and it takes them only about 3 hours! This amazing exodus is called a Batnado; we'll watch a video about it in a moment. But it can also be dangerous; colliding with one another, crashing into the cave walls or floor, or failing to get enough insects to eat can be deadly to the bats. Let's learn more about the Batnado process.

Play Batnado video:

<https://www.youtube.com/watch?v=AK3Dq3pm4Do>

We've experienced for ourselves some of the risks involved for bats when living in such large groups.

Question: What are some other risks that might make it difficult or dangerous for bats to live together in such a large colony?

- Limitations to food supply
- Collision or injury during flight
- Spread of disease in close quarters

And though there are risks, there must be a reason why the bats at Bracken Cave choose to live in such a large group anyway. **Question: Why might it be beneficial for bats, especially a maternity colony, to live in large groups?**

- Limited ideal roost locations
- Thermoregulation
 - » This is especially important for nursing maternity colonies
- Travel in groups to limit susceptibility to predation

Great thinking! So we know that living together can help to protect bats in a number of different ways; but, as we learned during our experiment, there can also be dangers. **Question: what strategies or adaptations do you think bats use in order to thrive in large groups?**

Echolocation

As you may know, while bats have good eyesight that helps them navigate when it's light out; they also use echolocation to gather information about the world around them, especially in dark caves and at night.

- Navigation
 - » Avoiding bumping into each other
 - » Avoiding colliding with objects, such as the cave walls
- Hunting
 - » Once bats have successfully left the cave, they can hone in on their prey using echolocation. Freetail bats use a 'feeding buzz', which is echolocation that gets faster and faster as they close in on their prey. Let's take a listen! We can also see a visual representation of the feeding buzz on these spectrograms.

Communication

Scientists theorize that, when species (like bats) live together in large groups over periods of time, it creates opportunities for communication and social groups to evolve. **Question: Why would communication be beneficial to a large group of bats?**

- Recognizing other members of your close social group
 - » One kind of bat society communication is between close family members, like mothers and their babies. In the intricate world of bats, the significance of call recognition

within families is demonstrated through the behavior of mother bats and their offspring in caves. Before baby bats are capable of flight, mothers leave them nestled on the cave's roof while they venture out for nightly hunts. Throughout the night, the young bats may move around frequently, making it challenging for mothers to pinpoint their offspring amidst the multitude of pups in the cave. However, each baby bat emits a unique call that serves as a beacon for its mother. This distinctive vocalization enables the mother to narrow down the search to the vicinity of her pup. Using her keen sense of smell, she then navigates through the crowded cave to reunite with her offspring and provide nourishment.

- » Maternity colonies can have multiple generations of mothers who identify and support their families
- Sharing information about food locations
 - » Bats can follow each other to food sources

Yes! Sharing information can be a huge benefit to large groups. Bats colonies can have different social structures, including **aggregations** and **societies**. Often, aggregations are groups that come together temporarily, for things like hibernating or migrating and don't share social bonds or do much in the way of sharing information. **Bat societies**, however, can live together for long periods of time, and many have close social and family bonds and do share more communication. **Question: When we did our experiment, did we more closely resemble an aggregation or a society?**

For the Bracken Cave Mexican Free-Tailed bat colony, quickly and safely getting out of the cave to follow the insect food supply is crucial. **Question: How do you think bat colonies use the behaviors we've discussed to help them do this successfully?**

We're going to try applying some bat strategies to see if we can increase our cave-exiting and insect-capturing success for the whole colony, including;

- Establishing a family echolocation call to identify each other, and to use when echolocating locations and prey.
- Using feeding buzzing to narrow in on prey
- Following each other to food sources

Question: Which strategy, adaptation, or combination, do you think will be the most effective? Why? (Rhetorical)

Ok! Now we're going to try the funnel exercise again. Remember, we want as many members of the colony as possible to survive the funnel, collect insects, and avoid bumping into each other or objects. Use your strategies to help. We will;

4. WALK, not run
5. Bats will keep their eyes closed
6. Please whisper your marco polo calls so everyone can hear more effectively

Divide students into three groups; 'Caves', 'Bats', and 'Bugs'. 'Cave' students should stand along the orange cones, and 'insect' students should hold the insect representations. Bat students are directed to again perform the collection exercise with their eyes closed, but will regularly call out 'Bat'. When 'Cave' and 'Bug' students hear the 'Bat' call, they should respond with their corresponding name; creating an echolocation game of Marco Polo. 'Bugs' should increase the frequency of their calls as bats get closer, mimicking feeding buzzes.

Give the 'Bat' group ~2 minutes to discuss strategies for success before beginning the game.

Time group for 10-20 seconds as they attempt to get through the funnel and gather insect items. If time allows, repeat the exercise with groups rotating through roles so everyone has a turn to be a 'Bat'. Then, guide the group through an activity review.

Time's up!

Sit down if;

- You picked up only one item or less
- If you bumped into anyone else during this game
- If you bumped into any objects during the game, including the funnel cones

Questions: How many of us are left standing? Were we more successful? Less successful? Are there more surviving bats this round?

Great job using your bat strategies to benefit the colony! Many bats around the world are endangered or threatened species, and anything that can help them survive and thrive is a major advantage. Protecting places like Bracken Cave which are important homes to bats can help ensure that bats can continue to live. **Question: We've explored how bats do their best to survive; why do you think it's important that bats continue to thrive?**

Sources

Bats! Curriculum book, Bracken Park cave, 12. Exploring Bat Caves

<https://www.batcon.org/bat/tadarida-brasiliensis/>

<https://academic.oup.com/bioscience/article/58/8/737/381072>

Glossary

Aggregate - To gather together into one large group or a large group of animals.

Batnado - The nickname for the way the colony of Mexican Free-tailed Bats at Bracken leave the cave each night. They fly in a tornado-like shape - hence the "batnado."

Colony - A group of individuals of the same species that live together usually for mutual benefit.

Echolocation - A process for locating objects by using sound waves. An animal using echolocation sends out sound waves that echo back to them.

Feeding Buzz - When a bat gets close to its prey it makes sound pulses that are closer and closer together eventually resulting in a "buzzing" sound when the prey is caught.

Roost - A place where animals regularly congregate to rest or sleep.

Society - A group of animals that associate with each other to form a cooperative structure.

Thermoregulation - A process by which animals maintain a consistent body temperature despite the external conditions of their environment.