



**BLOOMING**  
Inclusion and Diversity in STEAM

# Can Bats give us clues to our own health?

Evolution, Echolocation

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## Abstract

ONE FIFTH of all mammals in the world are bats so why are they so stigmatized in Western culture? Prof. Teeling believes that these fascinating creatures have a lot to teach us, with their uniquely high metabolic rates and surprisingly long lifespans. Professor Teeling studies mammalian phylogenetics and comparative genomics, with expertise in bat biology and the bat's genetic signatures of survival. Bats, despite using up three times more energy than other similar sized mammals, can live up to nine times longer than expected based on their energy consumption and body size. Generally, smaller animals and animals with a high metabolic rate have a shorter life expectancy than animals with a slower metabolic rate and larger animals like elephants for example.

## KEY TERMS

Evolution, Sound Waves,  
Echolocation

# Introduction

Bats have a unique ability to use sound to perceive their environment. This is called echolocation. They emit sound waves from their larynx which reflect off objects in their environment. The bats then hear these echoes, and they turn these echoes into an acoustic image. This enables them to orientate and find food in complete darkness.

One of the most unique things that bats do as a mammal is that they fly. In fact, while other mammals can glide, bats are the only mammal capable of true and sustained flight.

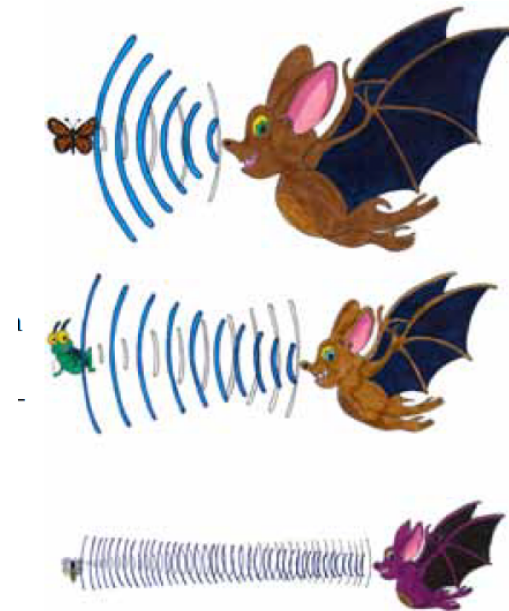
**Economic and Ecological importance of bats.** These mammals are pest controllers and pollinators.

**We can study bats to help us learn about our own health.**

Scientists have been looking at the unique sensory specialists, the bats, and have analyzed the genes that enable bats and other mammals to see and hear. In bats and other mammals that do not see that well, the scientists have searched for the genetic defects that may break these genes and could lead to blindness. They can then use these data to predict which sites are most likely to cause disease in humans.

**Bat DNA could contain the secret to everlasting youth.** Bats can live up to 9 times longer than expected despite having a high metabolic rate. There are 19 mammal species that live longer than man, and 18 of those are bats. Therefore, they must have something within their DNA that enables them to deal with metabolic stresses of ageing, particularly of flight.

## Methods



Echolocation

**Measure the speed of sound with:**

Two blocks of wood or any items that make a loud, sharp sound when struck together.

A stopwatch.

A friend to help with the exercise.

A tape measure.



## Women in STEM - Facts about the author.

[Emma Carole Teeling](#) (MRIA) is an Irish zoologist, geneticist and genomicist, who specializes in the phylogenetics and genomics of bats. Her work includes understanding of the bat genome and study of how insights from other mammals such as bats might contribute to better understanding and management of ageing and several conditions, including deafness and blindness, in humans.



# Instructions:

1. Find a large empty area such as a field or large court.
2. Choose two spots on opposite ends of the area where each person will stand.
3. Measure the distance between the two spots using a tape measure. Alternatively, you can count off measured steps between the two spots.
4. Have your friend take the blocks and stand at one spot, holding them up high.
5. Take the stopwatch and stand at the other spot. Make sure you have a clear view of the blocks.
6. Signal your friend to bang the two blocks together hard.
7. Start the stopwatch as soon as you see the blocks hit each other.
8. Press stop as soon as you hear the sound from the blocks.
9. Calculate the speed of the sound by dividing the distance between you and your friend by the elapsed time. To get a more accurate measurement, repeat the above steps a few times and then take an average of the results.

# Discussion

Bats can see as well as humans can, but they have evolved a sophisticated method of using sound that enables them to navigate and find food in the dark called echolocation.

The bats sense their environments and find prey by **calling out and listening for echoes made** as those sounds bounce off of objects.

**Bats produce echolocation** by emitting high frequency sound pulses through their mouth or nose and listening to the echo.

**Bats use different inner ear structures to help navigate the world through sound.**

- How to use echolocation for humans' navigation in the dark?
- Could we learn from the bats' inner ear anatomy?

**FUN FACT:** The French for bat is chauve-souris – bald mouse!.



**FUN FACT:** There are nine species of bat resident in Ireland. They are all insectivorous.



**FUN FACT:** The scientific name for bats is Chiroptera. What does this mean?



## Conclusions

**Most bats use sound to 'see' the world around them:** This nifty navigation system is called echolocation! Bats send out waves of sound from their mouths or noses, which bounce off their surroundings right back to their ears. By listening to the echoes, bats can build up a picture of exactly what's around them – including juicy insects!

**The scientific name for bats is Chiroptera**, which means 'hand wing'.

**When in flight**, bats hearts beat 1,000 times a minute!

**Bats are hugely important** for people and the planet.

## Resources :

- <https://www.ucd.ie/scienceforschools/BatsTYBookHighQualitySec1.pdf>
- <https://biologicalsciences.uchicago.edu/news/bat-echolocation-inner-ear-structure>
- <https://science.howstuffworks.com/how-to-measure-sound-travel-air.htm>
- <https://www.ucd.ie/scienceforschools/>
- <http://youtu.be/3BtbS9JC8x8> (great Irish bat clip)
- <http://www.eurobats.org>
- <http://www.csiro.au/Outcomes/Environment/Biodiversity/Spectacled-Flying-Fox/Bat-facts.aspx>
- [http://news.nationalgeographic.com/news/2005/01/0127\\_050127\\_bats\\_2.html](http://news.nationalgeographic.com/news/2005/01/0127_050127_bats_2.html)
- <http://www.csiro.au/Portals/Media/2011/Bat-immunity-key-to-controlling-deadly-viruses.aspx>
- <http://www.batconservationireland.org/>
- <http://www.thewildclassroom.com/bats/videos.html>
- <http://www.arkive.org/daubentons-bat/myotis-daubentonii/video-00.html>
- <http://www.nhm.ac.uk/nature-online/life/mammals/bats/session2/index.html>
- <http://www.rte.ie/radio/mooneygoeswild/factsheets/bat/>
- <http://www.bats.org.uk>
- [https://www.ted.com/talks/emma\\_teeling\\_the\\_secret\\_of\\_the\\_bat\\_genome?language=en](https://www.ted.com/talks/emma_teeling_the_secret_of_the_bat_genome?language=en)

## Reflection Questions (in bold the answer for each question)

1. What is echolocation in bats primarily used for?

- a. Communication
- b. Navigating through their environment
- c. Finding food**
- d. Attracting mates

2. Which part of a bat's body is responsible for producing echolocation calls?

- a. Eyes
- b. Wings
- c. Nose**
- d. Vocal cords

3. What is the purpose of bat echolocation calls?

- a. To locate prey
- b. To communicate with other bats
- c. To signal danger
- d. All of the above**

4. Which type of waves do bats emit during echolocation?

- a. Radio waves
- b. Sound waves**
- c. Light waves
- d. Magnetic waves
- d. Instantaneously, one call per millisecond

9. What advantage does echolocation provide to bats when hunting in complete darkness?

- a. Increased body temperature
- b. Enhanced vision
- c. Improved hearing
- d. Accurate spatial orientation**

## **Lesson Plan Title: Exploring Sound Speed** (connected with the bats' ability from the article above)

### **Objective:**

- Students will understand the concept of sound speed and how it travels through different mediums.
- Students will learn how to measure the speed of sound using a simple experiment.

### **Materials:**

- Stopwatch or timer
- Ruler or measuring tape
- Small balloons
- String
- Meterstick
- Small pieces of paper
- Small pieces of tape
- Pencils and paper for each student
- Whiteboard and markers

### **Introduction (15 minutes):**

1. Begin by discussing with students what they know about sound. Ask questions such as:
  - How does sound travel?
  - Can sound travel through different materials?
2. Introduce the concept of sound speed. Explain that sound travels at different speeds through different materials.
3. Share real-world examples where understanding sound speed is important, such as in communication systems or musical instruments. Explain bats' echolocation.

### **Activity - Measuring Sound Speed (30 minutes):**

1. Divide the students into small groups.
2. Provide each group with a balloon, string, ruler, and small pieces of paper.
3. Instruct each group to tie a balloon to the end of a piece of string, creating a simple pendulum.
4. Have the students use the ruler to measure the length of the string and record this length in their notebooks.
5. Next, instruct the students to pop the balloon and record the time it takes for the sound of the balloon pop to travel up and down the string.
6. Ask students to calculate the speed of sound using the formula:  $\text{Speed} = \text{Distance} / \text{Time}$ .
7. After completing the experiment, have each group share their findings with the class.

### **Discussion (15 minutes):**

1. Lead a class discussion on the results of the experiment. Discuss any variations in measurements between groups and reasons for those differences.
2. Emphasize that sound travels at different speeds through different materials, and the experiment focused on air as the medium.
3. Introduce the concept that sound travels faster through solids than through gases.

### **Conclusion (10 minutes):**

1. Summarize the key points of the lesson: the concept of sound speed and how to measure it.
2. Discuss real-world applications of measuring sound speed.
3. Assign a simple homework task related to sound speed, such as researching an invention or technology that relies on understanding sound properties.

### **Assessment:**

- Evaluate student understanding through group participation, the accuracy of measurements, and their ability to calculate sound speed.
- Challenge students to explore how sound speed varies in different mediums, such as solids, liquids, and gases, by designing additional experiments.