

SCIENTISTS IN THE FIELD

WHERE SCIENCE
MEETS ADVENTURE

DISCUSSION AND ACTIVITY GUIDE

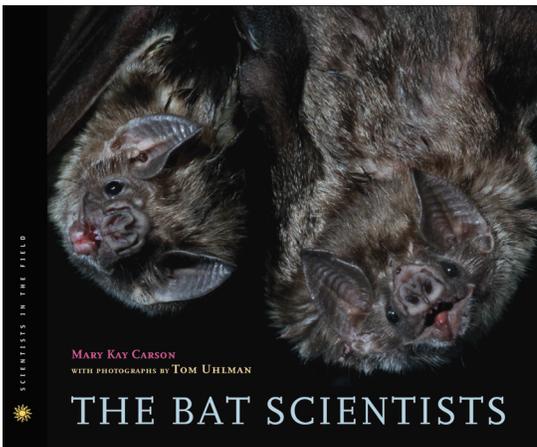
The Bat Scientists

By Mary Kay Carson Photographs by Tom Uhlman



About the Series

The Bat Scientists is part of the award-winning Scientists in the Field series, which began in 1999. This distinguished and innovative series examines the work of real-life scientists doing actual research. Young readers discover what it is like to be a working scientist, investigate an intriguing research project in action, and gain a wealth of knowledge about fascinating scientific topics. Outstanding writing and stellar photography are features of every book in the series. Reading levels vary, but the books will interest a wide range of readers.



About the Book

The author Mary Kay Carson follows scientist Merlin Tuttle, founder of Bat Conservation International, and his colleagues into bat caves, chronicling the difficult conditions they experience as they study and work to preserve these important creatures.

About the Author

Mary Kay Carson has always loved science and earned her college degree in biology. After serving in the Peace Corps, Mary Kay began her award-winning writing career by working on a classroom magazine, *SuperScience*, for Scholastic. She became a freelance writer and has written more than thirty books for young people, including *Emi and the Rhino Scientist*. She lives in Cincinnati with her photographer husband, Tom Uhlman, and her dog, Ruby. They all love to watch the bats flying over their yard on summer evenings.

About the Photographer

Tom Uhlman has been a freelance photographer for more than twenty years. He enjoys taking all kinds of photographs, but his favorite is nature photography. He often works with his wife, Mary Kay Carson, on books for young readers.

Pre-Reading Activities

Take two identical cardboard boxes (approximately 9x12x14) and tape a thermometer to the inside bottom of each. Close the boxes. Direct a fan to blow air at them. Make sure that both boxes receive the same amount of air and are the same distance from the fan. Make sure the two thermometers are recording equal temperatures in the boxes before starting. Using one box as the control box, have students carve five half-inch holes in the other box anywhere they choose. Students may also add dry materials to the inside of the box (no dry ice, etc.) in addition to the holes. After the holes are cut and any material added, close the box up and return the airflow from the fan next to the control box. The goal of cutting the holes and adding any material is to see if students are

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able to lower the temperature in the modified box. We will return to this activity after reading chapter three.

Examine the bones and wings of birds. What percentage of the total weight of a bird is just its bones? How much of a bird's body surface is just its wings?

Examine the skeletal structure of a human hand.

Develop a class definition of a pest.

Discussion Questions

What animals are considered pests? How much of our conception of pests stems from ignorance? How much of it stems from ecological imbalances? How much stems from human self interest?

What would happen to frogs, birds, bats, and other animals if mosquitoes became extinct? Could it ever become necessary to protect mosquitoes, spiders, cockroaches, or other animals commonly labeled as pests?

How are crops pollinated? What part in the pollination process do various species of animals play?

Many people regularly complain that they are misunderstood. What is something about you that other people just do not understand? Or, if this is not a concern, how do you go about making sure that people do understand you?

Think about something you enjoy doing. Now think about sacrifices you would be willing to make in order to keep doing this activity. How much are we willing to sacrifice in order to do a job we enjoy? When does the price of the sacrifice force us to move to other activities? Now change the terminology from "something you enjoy doing" to "something that must be done." Is there still a point in which the sacrifices are just too much?

When humans love something, they tend to share this information. For example, I may tell someone about a great sledding hill. Sometimes this shared love leads to a negative effect—the hill becomes so popular that all the snow melts. Our eagerness to see animals, for example, can cause destruction to habitats, introduce disease, and/or place high levels of stress upon the animals when too many people come looking. How do we balance our

excitement with the needs of the animal and the habitat? Who should be in charge of deciding the proper balance? What is the government's responsibility in establishing and maintaining the balance between our innate curiosity and the health of the habitat and animal?

Applying and Extending Our Knowledge

On page 16, Merlin Tuttle states that when he founded Bat Conservation International most people would rather have paid to kill a bat than to save one.

- Begin the exploration of this book by having each class member write down all the facts they know about bats and all of the myths they know about bats. Consolidate the information and keep it for reference as students proceed through the book. Make sure to confirm the facts on your list by citing the page numbers that confirm the information OR move the fact over to the myth and folklore section when a "fact" is proven false (include the page numbers here as well).
- In addition to confirming or rejecting facts students have listed, make sure to add important facts that were neglected upon creation of the list.
- Read a selection from *Dracula* by Bram Stoker talking about bats (see Mina Harker's September 30 journal entry) or watch a video clip from one of the vampire movies that includes bats. Create a Venn diagram showing the differences between real bats and bats in fiction or portrayed by Hollywood, as well as the similarities. Discuss the kernel of truth the author or director uses to exaggerate the fear factor. Why are some people so terrified of these small mammals?
- Research the number of rabies cases that result from dogs, skunks, raccoons, bats, and other mammals. Which animal presents the greater threat to humans of contacting rabies? How significant is the threat?
- Design an ad campaign to accentuate the benefits of bats to our world. If possible, make a sixty-second promotional video that can be shared electronically and shown at your school. Ideally, the bat selected as your subject should be one that is found in your area.
- Do a satirical video expose' (in a *Daily Show*-like

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format) outlining the slander and libel in fiction and media directed toward the vampire bat.

Common Core Connections

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-Literacy.WHST.6-8.6 Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS.ELA-Literacy.RI.6.1 Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

CCSS.ELA-Literacy.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

CCSS.ELA-Literacy.RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

CCSS.ELA-Literacy.SL.6.5 Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

Even before the first chapter, this book begins with a primer, “Bat Basics.” In this section we learn that there are more than 1,100 different bat species, living on every continent (except Antarctica), and ranging in wingspan from 6.5 inches to 72 inches (6 feet) across!

- Have students write down without discussion all of the different bat species they know about. Once each student has finished a list, form groups of four students and have them compare their lists. Each group will prepare a consolidated list of bat species. When the groups are finished, consolidate all of the group lists into one master class list of bat species. How many of the 1,100 bat species did the whole class identify? What species of bat was most frequently listed? Why?
- Assign your groups ten or more bat species to research. Prepare a map showing the ranges of their bats. Make index cards of each bat, listing range, size, description, diet, lifespan, and any special features that the group agrees are worth noting.
- Prepare an online slideshow to share of bats from

around the world from all of the different continents.

- A Google search of bat images will generate millions of images of bats. Go to your school or public library and have the librarian show you how to limit your search to find a wide variety of sites (called roosts) where bats sleep. Draw or print out all the different types of places in which bats have been found sleeping or roosting.
- If your school is in bat territory, build a bat house. Use the link on page 78 in the section “How to Help Bats.”

Common Core Connections

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-Literacy.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

CCSS.ELA-Literacy.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

CCSS.ELA-Literacy.SL.6.1a Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

CCSS.ELA-Literacy.SL.6.5 Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

Among the more serious threats to bats is white nose syndrome. Humans may be responsible for spreading the disease by carrying the fungus on their clothing or hiking gear. Another large threat to bats is humans disrupting hibernation and ruining caves. Bracken Bat Cave, one of the largest bat caves in the world, may be threatened by a planned subdivision proposed nearby.

- Research the most current news on threats to bats. Is the situation today worse for bats or are there signs of hope? Present your findings to the class.
- Present the most current findings about what white nose syndrome is and what causes it.

Common Core Connections

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on

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several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-Literacy.SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

On page 36 we read, "Echolocation means locating something with echoes. Like sonar, it's a way to get information about something by bouncing sounds off it.

... Bat echolocation is so precise that a bat can find a moth, tell how big it is, and know in which direction and at what speed it's moving, all in complete darkness."

- The object of this activity is to provide students with an approximation of "seeing" by using vibrations. Create an obstacle course with objects or paper or other materials that students move through. Have pairs of students hold opposite ends of a rope tightly. Give the students some time before starting the maze to work out a directional code with pulling or vibrations. One student will then guide the other, blindfolded student through the obstacle course using the pulls. Obviously the course should be safe and easily reconstructed for the next team.
- Try the same maze, but this time without the rope. Instead have the partner use a tuning fork to guide his or her partner. No talking! Once again, provide students with a five-minute planning time to work out a code with the tuning fork (what type of tone means "turn right," etc.).

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

On page 44 we are given the basics of a bat cave. On page 45 we see a diagram of how a cave traps cold air. Return to the pre-reading activity that had students attempting to lower the temperature of one box by cutting holes in it.

- Using the information on these two pages, try again to design the inside of the box, the holes, and the airflow to lower the temperature. Discuss why or why not you were able to lower the temperature.
- What factors would you have to control to make a cave that circulates air and traps the cold air as de-

picted on page 45?

- Do a variation of this activity, but use clay or other materials.
- If we wanted to design a house that stayed cool without air conditioning, could we use the principles in a bat cave to help us? Draw and label your answer. Write a paragraph explaining your reasoning. This activity is easily adapted for partners.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Our primary method of communication is with language, with words. However, we often overlook the importance of our visual communication. When we are communicating in print or electronically, we lose much of the communication packet that is transmitted by visual clues (primarily). We do not have body language to help interpret the emotional core of the message.

Bats are social creatures that click and squeak and cuddle. Is it all sound, all squeaks, and clicks, or do bats also rely on visual communication? Are the bat clicks and squeaks more important than their eye sight?

- Have students write a script for *Stellaluna* by Janell Cannon to perform for elementary students.
- Create a musical score and create a basic set for the adaptation of *Stellaluna*.
- Create a teacher's guide for the teacher to share with students before you perform, highlighting the factual information about birds and bats.
- After the performance, share more factual information about bats and birds and answer student questions.

Common Core Connections

CCSS.ELA-Literacy.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

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CCSS.ELA-Literacy.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

· CCSS.ELA-Literacy.SL.6.5 Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

· CCSS.ELA-Literacy.SL.6.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 6 Language standards 1 and 3 here for specific expectations.)

As much as we may admire and understand bats, we may not be able to imagine walking in fecal matter filled with beetles. These beetles quickly remove all traces of footprints and even gnaw the flesh off the bones of baby Mexican free-tailed bats unfortunate enough to fall into these living guano piles. We haven't even mentioned the need to clean the mites that drip like rain inside the dark bat cave from our hair. Have we told you about the humid, one hundred degree temperature or the persistent and dangerous ammonia fumes? (pp. 13–15).

- In the discussion questions, we asked what sacrifices you would be prepared to make for a career that you loved. In groups, discuss what kind of person you think Dr. Merlin Tuttle is.
- Discuss whether or not you could be a bat scientist.
- Are bats important enough for a personal sacrifice?
- Regardless of the organism scientists study, much of the work involves guano, or feces, dung, poop. It also involves observing the animal regularly through all kinds of weather and conditions. Is there an animal or a habitat worth making personal sacrifices for you? Make a list of all the pros and cons of studying an animal like a bat.
- Research the uses for bat guano. Prepare an advertisement for bat guano. Who is the target market? What would make the target market likely to purchase bat guano?
- Research the animals that live in a bat cave, like Bracken Bat Cave. Extra credit for finding pictures of the beetles! Make or draw a scale model of a cave and its residents.
- Write a short story told from the point of view of a beetle or a baby bat in Bracken Bat Cave.

- Compare Batman's Bat Cave with a real bat cave.

Common Core Connection

CCSS.ELA-Literacy.WHST.6-8.1 Write arguments focused on discipline-specific content.

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

On page 74 we read, "Scientists aren't completely sure how wind turbines kill bats. Many of the dead bats found at wind farms show no injuries. Rather than being struck by the turbines, many bats appear to be killed by a sudden drop in air pressure near the spinning blades. Like those of a scuba diver coming up too fast, the tiny blood vessels inside the bats' delicate lungs explode."

- Plot the location of bat migration routes and the location of wind turbine sites in the United States. Which bats are in danger?
- Write to a wind energy company and ask them to respond to the threat wind turbines pose to bats. If any companies respond, share that information with a bat conservation organization. Pretend you are a Supreme Court justice writing the majority opinion of the court on what to do about wind turbines and bats. Weigh the evidence and make a ruling.

Common Core Connection

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-Literacy.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

On page 33 there is a graphic comparing a human arm with a bat wing. The title is "Same Bones, Different Sizes."

- Design a human arm as a wing using existing bones. What size would the bones need to be? Draft, draw, mold, or paint your answer.
- Suppose humans evolved to fly and bats evolved to walk upright—design and write about what the world would be like today.

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Common Core Connection

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-Literacy.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Further Reading

Diane Bair and Pamela Wright. *Bat Watching: A How-to Guide*. Capstone, 2000.

Other Websites to Explore

Echolocation – Bats

URL: askbiologist.asu.edu/echolocation

An informative site called Ask a Biologist from Arizona State University, about bats and echolocation.

White Nose Syndrome Information for Students and Teachers

URL: whitenosesyndrome.org/resources/education

An extensive list of educational resources for teachers and students on White Nose Syndrome. Includes links to articles, websites, FAQ's, teaching resources, videos and activity sheets.

Guide created by:

Ed Spicer, Curriculum Consultant, and Lynn Rutan, retired middle school librarian, now reviewer and blogger at Bookends: the Booklist Youth Blog

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