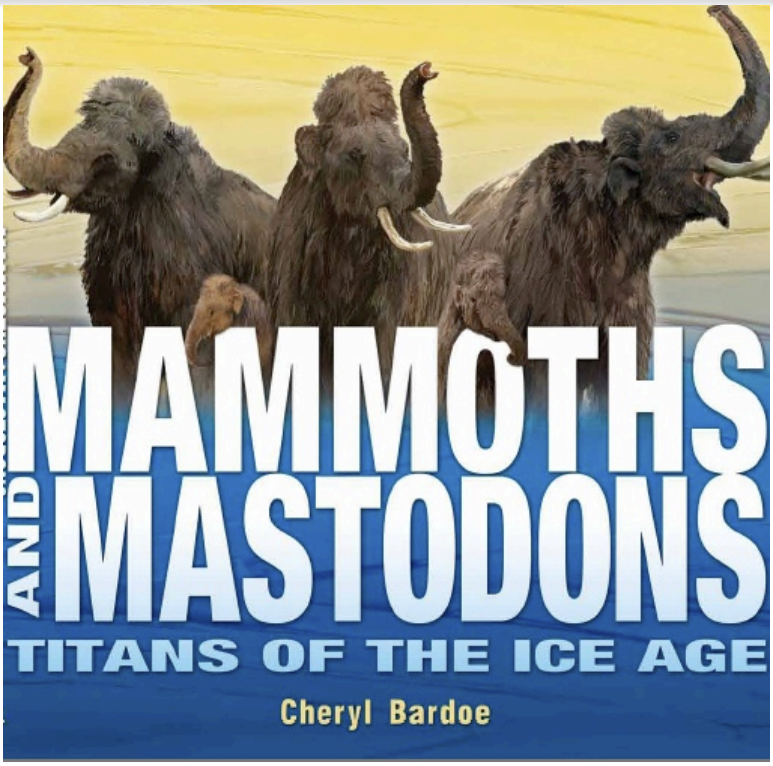
Educator Guide – Science Activities



Ages 9-12, Abrams Books for Young Readers,
ISBN-10: 081098413X ISBN13: 978-0810984134

Mammoths and mastodons roamed the earth for millions or years, and then suddenly went extinct. What was everyday life like for these colossal cousins of the modern elephant? How did they fit into their Ice Age landscape? Why did they disappear?

Theories are raised and answers provided in this intriguing book that presents the latest research, drawing on the recent discovery of a baby mammoth that had been frozen in the arctic tundra for 40,000 years. By studying the extinct creatures, researchers hope to discover ways to keep elephants from suffering the same fate.

★ Junior Library Guild Selection

"Although the animals are long extinct, Bardoe makes clear their relevance." ***—The Washington Post***

"A highly intelligent account of an important scientific mystery." ***—American Archaeology***

Cheryl Bardoe shares her love of writing and fascination for nature with young people through books and school visits. She has an MFA in creative writing for children and young adults.

Mammoths and Mastodons connects to a traveling exhibition created by The Field Museum in Chicago.

Visit www.fieldmuseum.org to find out where your students can see the exhibition.

Also by this Author

Gregor Mendel: The Friar Who Grew Peas
Abrams Books for Young Readers
ISBN10: 0810954753 ISBN13: 978-0810954755

★ NCTE Orbis Pictus Honor

★ ALA Notable Book ★ IRA Notable Book

The Ugly Duckling Dinosaur
Abrams Books for Young Readers, Spring 2011

Activity 1: Uses of Technology

Objective: Explore the role of technology in excavating and examining fossils.
National Science Standards: Science and Technology, Science as Inquiry
Illinois Science Standards: 13B Know and apply concepts that describe the interaction between science, technology and society.

Step 1: ***Read pages 14-17, "Reading Tales in the Tusks."*** Ask students to describe the use of each tool featured in the text or pictures, and explain why they think each tool was selected for its task. Tools used: ■ table saw ■ precision saw ■ microscopes ■ tweezers ■ flashlight ■ CT scanner ■ endoscopic camera to explore guts

Step 2: ***Explore these online resources to observe more scientific tools. Ask students to identify each tool and explain how it is used.***
■ Exhibition sites of Field Museum scientists excavating mastodon remains in Illinois and dinosaur fossils in Wyoming.
http://www.fieldmuseum.org/expeditions/kissel_expedition/about.html
http://www.fieldmuseum.org/expeditions/pete_expedition/about.html

■ National Geographic site for *Waking the Baby Mammoth* features pictures and videos of scientists examining the baby woolly mammoth Lyuba, plus an interactive to let students examine the baby mammoth themselves.
http://channel.nationalgeographic.com/episode/waking-the-baby-mammoth-3630/technology

Step 3: ***Discuss the tools and technologies scientists use.***
■ Ask students to categorize the tools according to which are high-tech and low-tech.
■ What is the purpose of the different types of tools in the scientists' work?
■ How does the ability to make CT scans and conduct endoscopic investigations increase the data available to scientists?
■ What is the role of the scientist in interpreting the data made available by these technologies?

Activity 2: Analyzing Scientific Research and Debate

Objective: Model how science is the ongoing process of gathering and analyzing physical evidence to better understand the natural world.
National Science Standards: Science as Inquiry, Science in Personal and Social Perspective, History and Nature of Science
Illinois Science Standards: 11A Know and apply the concepts, principles and processes of scientific inquiry. 13A Know and apply the accepted practices of science.

Step 1: ***Examine types of scientific inquiry.*** Read p. 14-17 "The Tale in the Tusks," p. 28-31 "Prehistoric People and Mammoths," and p. 39-41 "Saving the Elephants." Ask students to complete the Scientific Research Analysis sheet (below).

Step 2: ***Examine a scientific debate.*** Read p. 32-38. Identify and list:
■ historic misinterpretations of mammoth fossils that have been corrected with the accumulation of scientific knowledge.
■ evidence supporting the theory that overhunting is why mammoths became extinct.
■ evidence supporting the theory that climate change caused the extinction of the mammoths.

Step 3: ***Guiding questions for discussion:***
■ Explain how scientists draw upon physical evidence to support each theory of extinction.
■ Explain why scientists do not have consensus that one of these theories is the main culprit.
■ Explain the implications each theory has for the environmental issues we face today?
■ Explain how scientific theories change as more information becomes available.

Extension Activity: Ask students to investigate threats to the survival of elephants and other endangered animals. Or the reasons that other animals have gone extinct in the past 200 years.

Activity 3: The Intersection of Art and Science

Objective: Model the process that scientists and scientific illustrators use to interpret fossil evidence and knowledge of animals' habitats to create images of extinct species.
National Science Standards: Science as Inquiry, Life Science (The characteristics of organisms, Organisms in their environments), History and Nature of Science
Illinois Science Standards: 11A Know and apply the concepts, principles and processes of scientific inquiry. 12B Know and apply concepts that describe how living things interact with each other and with their environment.

Step 1: ***Tell students that they are scientific illustrators who have been hired by a museum to create pictures of the extinct woolly mammoth.*** Explain that just as authors conduct research before writing a book, illustrators conduct research too. All of the following steps will help students gather information needed to create their illustrations.

Step 2: ***Show students the mammoth skeleton on page 48*** (cover up the picture of Lyuba on the facing page). Compare and contrast this skeleton to pictures of the skeletons of dogs, bears and/or cows. Pay particular attention to:
■ necks ■ jawbones ■ vertebra extending up from the spine and ribs extending below the spine ■ legs and feet ■ teeth (including tusks)

Step 3: ***Demonstrate the scale of a woolly mammoth***. Outside, measure chalk rectangles that represent the height and length of the animals whose skeletons students studied. Start with the smallest animal first. Save the woolly mammoth for last—11 ft x 12 ft to represent height by length. (A side view of a mammoth's body and skull would fit in this box. Tusks would stick out further.) Students can also draw their own outlines within this rectangle. In bad weather, students can measure heights inside.

Step 4: ***Compare the mammoth skeleton to an elephant skeleton,*** and add an elephant skeleton to the measuring chart. What are the similarities? Which bones are different?

Step 5: ***Ask students to pretend that they have never seen pictures of a woolly mammoth.*** Based only on looking at the skeletons and the sense of scale, and knowing what elephants look like, what attributes do they think the mammoth would have for its body shape? Where might its shape be different than an elephant's shape?

Step 6: ***Look at the map on page 8 to see where woolly mammoth bones were found.*** Based on what students know about northern climates, what can they guess about the animal's body covering? Would it be similar to or different from that of elephants living in Africa and Asia? Read the sidebar on page 10. If large ears and long tails allow heat to escape from elephants' bodies, then how might students guess that woolly mammoth ears and tails would be adapted for the cold?

Step 7: ***Share the Behind-the-Scenes with a Scientific Illustrator sheet*** (below) so that students can hear about the process that scientific illustrator Velizar Simeonovski used for *Mammoths and Mastodons*. Point out how the artist gathered "visual references"—which are images (rather than text) that convey relevant information—to aid in his illustrations.

Step 8: ***Ask students to bring in visual references of elephants and the animals*** that the illustrator mentions regarding fur (musk oxen, bison and bears).

Step 9: ***Ask students to create their own illustrations of woolly mammoths, based on their research.*** Students should look closely at the shapes of the skeletons, and the muscles and fur on their visual references.

Step 10: ***Create an exhibition of the scientific illustrators' artwork.*** Students can attach the visual references they used to the finished art and write a paragraph about their process.

Extension Activity: Compare the physical attributes of the animals in the Probiscidean Family Tree on pages 12-13. Ask students to make their own chart identifying how differences in body size, shape, ears, tails, fur relate to each animals habitat.

Scientific Research Analysis

Identify Dr. Fisher's hypothesis about the tusks.

Describe the physical evidence that suggested his hypothesis.

Identify the research methods he used to investigate his hypothesis. What physical evidence did he examine?

Explain how the discovery of the baby woolly mammoth Lyuba provides important evidence for Dr. Fisher's theory.

Identify Dr. Fisher's hypothesis about how Ice Age peoples stored meat.

Describe the physical evidence that suggested this hypothesis.

Identify the research methods he used to investigate his hypothesis. Describe the physical evidence he examined.

Identify the hypothesis that park managers at the Kruger National Park in South Africa thought explained the loss of trees in the park?

Describe the physical evidence that suggested this hypothesis.

Identify the research methods Dr. Codron used to investigate this hypothesis. Describe the physical evidence she examined.

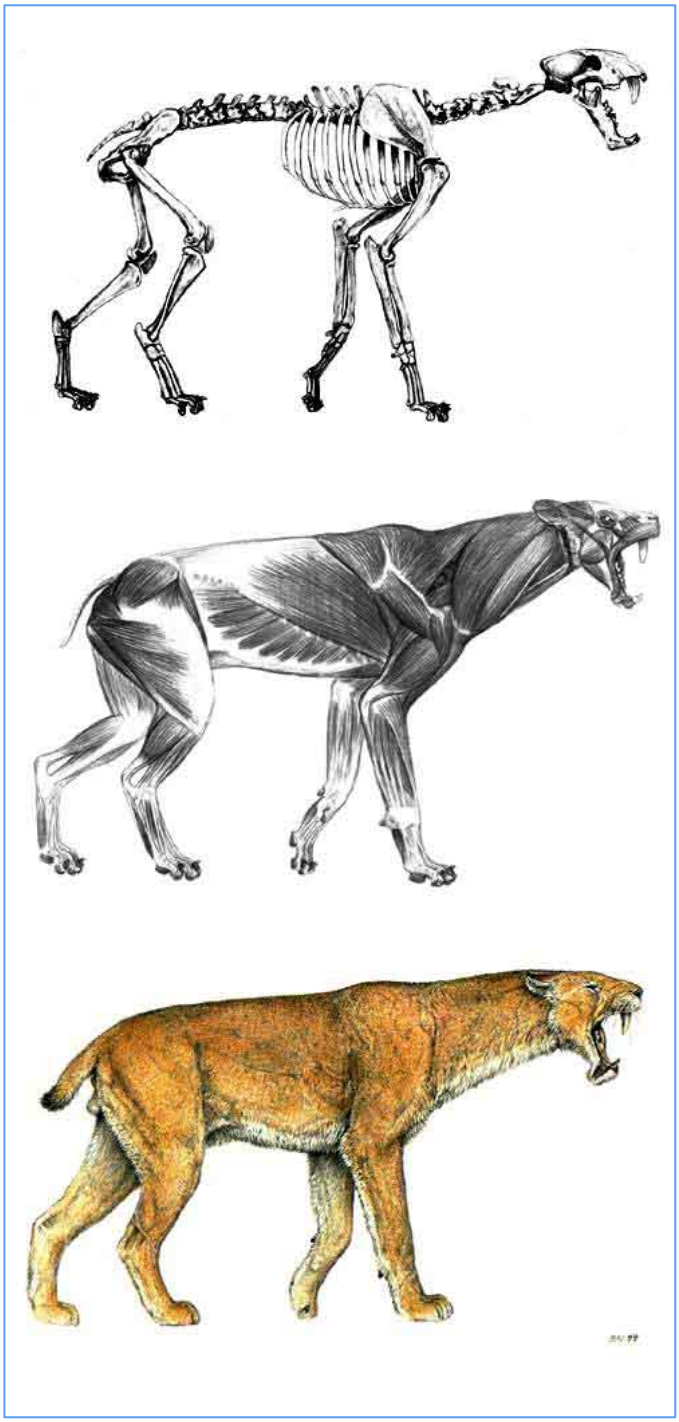
Explain how her conclusions differed from the original hypothesis.

Behind the Scenes with a Scientific Illustrator:

Learn how Velizar Simeonovski created the prehistoric animals in *Mammoths and Mastodons: Titans of the Ice Age*

Vel starts his scientific illustrations with a detailed examination of the fossils available from a prehistoric animal. He compares the skeleton to those of other animals that would have lived at the same time, and to those of other animals alive today.

He first draws the prehistoric animal's skeleton. Then he draws the prehistoric animal with muscles on its skeleton. Finally, he draws the prehistoric animal with its skin and fur.



To create the illustrations in *Mammoths and Mastodons: Titans of the Ice Age*, Vel gathered many photos of animals living today:

■ He studied musk oxen to model the long fur along the flanks. We know mammoths had such long fur because of cave paintings. This fur is an adaptation for living in open areas with brutal winds—the long hairs along the flanks protect the belly from the freezing wind.

■ He studied bears to create realistic variation in the coloring of mammoth fur. Even within a species, animals may have fur of a variety of colors, just like humans have many different colors of hair. Like mammoths, bears are large enough that full-grown, healthy individuals have no predators other than humans. This means that the color of their fur is not related to being camouflaged from predators.

■ He studied bison because these animals live in both open prairies and in woodlands. This informed the differences of color between the mammoths and mastodons.

Vel also had images of woolly mammoth fur that had been preserved in the tundra. This was helpful to get a sense of color and texture. But we can't assume that the texture and color didn't change over thousands of years.

Vel combined his research and imagination to create the images in *Mammoths and Mastodons: Titans of the Ice Age*.