

Tales Told by Fossils: Fossils as Evidence of the History of Life

GRADE LEVEL

Grades 6-8

SUBJECTS

Science/Evolution-Fossil Record

ESTIMATED TIME

Three or more 50-minute sessions

"Once in the sun-fierce badlands of the west...we found a sabertooth, most ancient cat, far down in all those cellars of dead time."

OVERVIEW

This activity is a laboratory investigation of form, function and adaptation using Loren Eiseley's "The Innocent Assassins" as a starting point. In this series of lessons, students will develop an understanding of diversity, identify questions and form hypotheses that can be examined through scientific investigation, design and conduct a scientific investigation, and investigate the unique structures of fossil organisms.

This lesson could also be adapted to other grade levels, depending on students' levels of sophistication.

MATERIALS AND TECHNOLOGY

- Replica of the sabertooth specimen referred to in "The Innocent Assassins."
- A copy of the poem "The Innocent Assassins" from *The Loren Eiseley Reader* for each student in the class.
- A copy of the handout for this lesson plan for each student.

Web-based resources:

<http://www.ucmp.berkeley.edu/mammal/carnivora/sabretooth.html>
<http://www.enchantedlearning.com/subjects/mammals/smilodon/>
<http://www.sciencedaily.com/releases/2004/01/040113081137.htm>
<http://www.sciencedaily.com/releases/2007/10/071001172812.htm>

Books:

The Loren Eiseley Society. *The Loren Eiseley Reader*. Lincoln: Infusionmedia Publishing Inc., 2009.
<http://www.eiseley.org>

Kurten, Bjorn. *The Innocent Assassins*. New York: Columbia University Press, 1991.

Carroll, Robert. *Vertebrate Paleontology and Evolution*. Freeman, 1990.

PREPARATION

1. Read the poem "The Innocent Assassins" in *The Loren Eiseley Reader*.
2. Make sure every student has a copy of the poem and/or *Reader*.
3. Make copies of all handouts and have all materials available for use.

INSTRUCTIONAL PLAN

STUDENT OBJECTIVES

In this series of lessons, students will

- investigate adaptation of fossil organisms,
- understand the relationship between form and function,
- understand the fossil record as a record of the history of life, and
- understand the logic of historical inference.

PROJECT SEQUENCE

After introducing the students to the poem "The Innocent Assassins," any of these activities could be undertaken:

1. Have students examine the skull of the sabertooth and make observations of features they find striking or remarkable. They should make some notes describing what they see.
2. Explain that what they have been examining is a replica of a fossil found in western Nebraska. Lead the students in a discussion of what they think they can or would like to find out about the animal represented by the fossil. Get them to develop questions that could be investigated and make a list of the questions that are proposed.

DISCUSSION (oral contribution): If they don't come up spontaneously, some questions that would be useful to explore could be introduced to the discussion:

- How did an animal like this make a living, especially, how might it have used the large, saber-toothed canines?
 - Are there other animals with saber teeth like this? As fossils? Still living?
 - Why are sabertooth cats like this extinct?
 - One saber of this individual is imbedded in the bone of another animal (depending on the level of the group and what resources you have available, you may wish to tell them it is the upper arm bone of another sabertooth or let them figure that out for themselves). What happened here? What is the story behind this fossil occurrence?
3. Break the class up into smaller groups of three or four students to research the questions generated in discussion. Assign each group one question (one question could be given to two or more groups if the class is large). Have each group examine the question assigned to them and come up with a method and kinds of evidence that could help them answer it.
 4. Each research group of students should record their proposed method of study and the type of evidence they wish to seek. Within the limits of the resources available to them, they should proceed with the proposed research to try to answer the question. Resources available to the students could include: the fossil replica, which students could take turns reexamining for further details; online resources; books available in the classroom; the teacher could have important information or other resource materials that can be made available if asked for.

Possible Research Topics

The function of sabertoothed canines: some lines of investigation that students might pursue for this question include:

- analyzing the characteristics of the saber tooth itself, sharp point, sharp, serrated edge, long with a narrow cross section, and considering what actions it would be capable of
- examine the rest of the skeleton as represented by the specimen or in online or other sources, to see if it offers any additional clues to the capabilities and likely life characteristics, such as diet
- compare them to living animals with similar characteristics (if there are any)
- compare them to human made tools that are similar in form and have a known function
- see if others have investigated this question and made their results available by publication

The diversity of sabertooths: students will have to rely on online resources, books and/or teacher-provided materials to pursue this question. Some information they could look for would include:

- How many different kinds of sabertoothed animals are known? (The genus level is most likely to yield comparable data from different sources.) Note: the Wikipedia resource is useful for this, as is Carroll's book.
- Where and when did each live, and how closely are they related to one another and to other groups of animals?
- With this information they can consider the relative success of the sabertooth adaptation.

Extinction of the sabertooths: students may wish to consider the question of how particular species of sabertooth became extinct either because of or in spite of such an impressive adaptation. Another approach would be to try to explain why there are no modern animals that have the sabertooth adaptation.

Sabertooth CSI: explaining how this particular sabertooth died and became part of the fossil record will require that the students think about how its tooth got imbedded in another animal's bone.

It will be important for them to know that it is the bone of another sabertooth and that it is an upper arm bone (*humerus*). With illustrations of skeletons, they can work out the orientation of the 2 animals. At some point they can be given a picture of the artist's interpretation of the scene.

They may wish to consider why animals of the same species are entangled in this way, and why they remained so. Eiseley's poem offers part of an explanation. What evidence and observations support whatever interpretation they come up with?

5. When each group has taken their research as far as resources or time allows, the students in that group should prepare a report on what they have discovered, the information, their conclusions concerning the initial question and recommendations for further work.
6. Each group will present their report to the whole class, and the class should discuss the results of the individual reports as well as the connections between topics investigated by different groups.

Glossary of Terms for “Innocent Assassins” Video

Term	Meaning
cones	Anything shaped liked a cone: sawdust piled up in a great cone; the cone of a volcano, an ice Cream cone, a solid having a circular base and sides that slope evenly to a point
runneled	A small channel, a small stream of water.
purgatorial	Removing or purging sin; expiatory; purgatorial rites. Serving to purify of sin; expiatory.
sabertooth	Any of several extinct members of the cat family felidae from the Oligocene to Pleistocene epochs, having greatly elongated, saberlike upper canine teeth. False sabertoothed tigers. Short legs; dog -like feet.
cellars	An underground room or story.
Toledo steel	Toledo, Spain is known for making swords and sabers that are especially hard and of superior quality.
serrations	A series or set of teeth or notches.
Cretaceous	From 140 million to 65 million years ago, characterized by the greatest development and subsequent extinction of dinosaurs and the advent of flowering plants and modern insects.
scapula	Either of two flat, triangular bones, each forming the back part of a shoulder in humans; shoulder blade.
undetached	Not attached; separated;
mortal	Deadly or implacable; relentless: causing or liable to cause death; fatal:
fangs	One of long, sharp, hollow or grooved teeth of a venomous snake by which poison is injected. A tooth resembling a sabertooth.
immortality	Not mortal; not liable or subject to death; undying:
beget	To cause ; produce as an effect: to cause to exist or occur; produce:
genes	The basic physical unit of heredity; a linear sequence of nucleotides along a segment of DNA that provides the coded instructions for synthesis of RNA, which, when translated into protein leads to the expression of hereditary character. A male given name, form of EUGENE. a portion of a DNA molecule that serves as the basic unit of heredity. genes control the characteristics that an offspring will have by transmitting information in the sequence of nucleotides on short sections of DNA.
assassin	A murderer.
eras	A period of time marked by distinctive character, events, etc.: a major division of geologic time composed of a number of periods.
uncertainties	Not for sure, not sure to happen.
unfostered	Not to bring up, raise or rear, not to care for.

perverse	Willfully determined or disposed to go opposite to what is expected or desired; contrary. Persistent or obstinate in what is wrong. Turned away from or rejecting what is right, good, or proper; wicked or corrupt. Contumacious, disobedient. Stubborn, headstrong, evil, bad, sinful.
antique	Of or belonging to the past; not modern. Any work of art, piece of furniture, decorative object, or the like, created or produced in a former period, or according to U.S. customs laws, 100 years before date of purchase.
inchoate	Not yet completed or fully developed; rudimentary. Just begin; incipient. Not organized; lacking order:
dim	Lacking in brightness: a dim room. Emitting only a small amount of light; lacking keenness or vigor.
creature	An animal, the creatures of the woods and fields; an animate being.
cunning	Sly, crafty, deceiving.
outworn	Out of date, outmoded, or obsolete: worn-out, as clothes.
ancient	Dating from a remote period; of great age: a very old or aged person, esp. if venerable or patriarchal.
flint	A hard stone, a form of silica resembling chalcedony but more opaque, less pure, and less lustrous. A chunk of this used as a primitive tool or as the core from which such a tool was struck. A small piece of metal, usually an iron alloy, used to produce a spark to ignite the fuel in a cigarette lighter.
inanimate	Not animate; lifeless.
murmur	A low, continuous sound, as of a brook, the wind, or trees, or of low, indistinct voices. To speak in a low tone or indistinctly.
atavists	The reappearance in an individual of characteristics of some remote ancestor that have been absent in intervening generations. Reversion to an earlier type; throwback.
unchosen	Not chosen. Not picked.
mesmerically	Compelling; fascinating.
paleontology	The science of the forms of life existing in former geologic periods, as represented by their fossils.
Mauvaises Terres	The "Bad Land" in French. This ground has many deep canyons and bluffs so it is bad to travel over.
voyageurs	A person who is an expert woodsman, boatman, and guide in remote regions, esp. one employed by fur companies to transport supplies to and from their distant stations.
Tertiary	Noting or pertaining to the period forming the earlier part of the Cenozoic era, occurring from 65 million to 2 million years ago. Characterized by the development and proliferation of mammals.
faunas	The animals of a given region or period considered as a whole. A treatise on the animals of a given region or period.
excavations	To make a hole, to dig out of a earth.

sterile	Free from living germs or microorganisms; aseptic: incapable of producing offspring; not reproducing. offspring. Barren; not producing vegetation: noting a plant in which reproductive structures fail to develop.
imprinted	A mark made by pressure; a mark or figure impressed or printed on something. Any impression or impressed effect.
enormous	Greatly exceeding the common size, extent, etc.; huge; immense: outrageous or atrocious.
magnitude	Size; extent; dimensions: greatness of size or amount. Moral greatness.
abstraction	An impractical idea; something visionary and unrealistic. Absent-mindedness; inattention.
arroyos	A small steep-sided watercourse or gulch with a nearly flat floor; usually dry except after heavy rains.
teetering	To move unsteadily. To ride a seesaw; teeter-totter. A seesaw; motion; wobble.
pinnacles	A lofty peak. Any pointed, towering part or formation, as of rock.
dinosaur	Any chiefly terrestrial, herbivorous or carnivorous reptile of the extinct orders saurischia and ornithischia, from the Mesozoic era, certain species of which are the largest known land animals.
osmosis	The diffusion of fluids through membranes or porous partitions.
fragmented	A broken part, off or detached:
