



# Global Processes

## High School

### Duration

Pre-Visit: 30-40 minutes

Museum Visit: 60 minutes

Post Visit: 60 minutes

### Location

Age of Mammals Hall

### Supplies

- Worksheet
- Pencil
- Clipboard (optional)
- Presentation materials

### Standards

#### [NGSS](#)

HS-LS2.A, HS-LS2.D, HS-LS3, HS-LS4

#### [S+E Practices](#)

3,5,6,7,8

#### [CCSS ELA](#)

WHST.9

#### [CA State](#)

Biology/Life Science

8.a.b.e

### Vocabulary

Evolution · Natural Selection · Selection Pressure · Adaptation Speciation · Extinction · Geology · Fossil · Fossil Record · Comparative Anatomy

## Concepts

- Evolution is the result of genetic changes that occur in changing environments.
- Natural selection is the mechanism by which evolution occurs.
- Evidence from geology, fossils and comparative anatomy provide the basis for the theory of evolution by natural selection.

## Objectives

- Students will be able to articulate an example of evolution by natural selection.
- Students will investigate the evolutionary history of a mammal.
- Students will visually and orally present their research to the class.

## Outline

1. In one classroom session before visiting the Museum, review vocabulary and the concept of evolution by natural selection. Have students watch the short film, *Global Processes* and choose a mammal to focus their research project.
2. During a trip to the Museum use the Age of Mammals hall to review content and have students begin researching for their presentations.
3. Back in the classroom, students will continue their research and work on their presentation, and present their findings to the rest of the class.

## Pre-Visit

Teachers Note: The following worksheets are designed to be photocopied front and back, in the order below, for a total of two handouts to students.

In your classroom, review the concept of evolution by natural selection. Distribute the *Vocabulary* sheet below to enhance or begin the review.

Show the class the short film *Global Processes* on the NHM's YouTube channel: [www.youtube.com/user/NHMLA](http://www.youtube.com/user/NHMLA). Click on Exhibits, Global Process. Or go to: <http://www.youtube.com/watch?v=ApsCGttW2Us&feature=share&list=SP37FA960FC8DA9259>

After watching the video, lead a discussion with the class using the following questions as prompts. Encourage the use of appropriate vocabulary:

- How would you sum up the major events of this process? (ex: continents moved, climates changed, mammals evolved)
- What aspects of this process could have contributed directly to evolution? (ex: habitats changed, mammals could migrate to new environments)
- Why do we study the past?

Share the research project with the students, and have them choose a specimen to focus their project on using *The Specimen/The Project* worksheet (either as individuals, pairs or teams). Students may choose to begin research at home or in class before the Museum visit.

## Museum Visit

Gather students in front of *Global Processes* and watch the video for review, then move to the *Evolutionary Explosion* exhibit (first row of specimens on your right as you enter the hall) and ask the following questions:

- How does the early mammal relate to the modern mammals seen here? (Each fossil specimen on the platforms to the right is an early ancestor of the extant specimen on the same level platform to the left)
- What physical differences can you identify?
- What factors (selection pressures) might have led to those changes over time (reference vocabulary list if helpful).

Review the goal of the project and give students time to collect information on their specimen. Distribute the *Research* worksheet (if students do not already have it) and emphasize that the graphic organizer is meant to help guide collection of information, but a complete project may include information not outlined on the organizer. There is additional space on the back page for more notes, and students may find they need even more space to record information. Encourage critical thinking and specific note taking. Photography is allowed if students would like it for their presentation. Students may choose to continue researching at home or in class after the Museum visit.

## Post-Visit

Each student, pair or group will develop and share a presentation that discusses their research about the evolution of their specimen using either a digital slide show (such as PowerPoint or Key Note) or a poster. The presentation should include the use of images and have a written and oral component.

## Variations and Extensions

- Instead of a formal research presentation, have students write the evolutionary story or their specimen as a narrative.

## Vocabulary

Review and become familiar with these terms.

Vocabulary	Definition
<b>Evolution</b>	The change in organisms (as a consequence of changes in their genes) over time due to selective pressures from their environment.
<b>Natural Selection</b>	The process through which traits that aid survival and reproduction become more common, and traits that hinder survival and reproduction become more rare.
<b>Selection Pressure</b>	A force that causes a particular organism to evolve in a certain direction, i.e. the forces that drive Natural Selection.
<b>Speciation</b>	Formation of new and distinct species, whereby a single evolutionary line splits into two or more genetically independent ones.
<b>Episodic Speciation</b>	Circumstances that allow a new species have an opportunity to expand their populations in a more conducive environment. For example, mammals had greater resources available to evolve after the mass extinction of the dinosaurs.
<b>Biodiversity</b>	The diversity of living organisms found in a given environment. Sometimes habitat diversity (the variety of places where organisms live) and genetic diversity (the variety of traits expressed within a species) are also considered types of biodiversity.
<b>Adaptation</b>	A feature an animal has (physical) or does (behavioral) feature that is important for its survival.
<b>Climate</b>	Temperature, humidity, atmospheric pressure, wind, rainfall, and numerous other meteorological elements in a given region over long periods of time.
<b>Geology</b>	The study of the earth and its history as recorded in rocks and minerals.
<b>Fossil</b>	Evidence of pre-historic life. A remnant or trace of an organism of a past geologic age, such as a mineralized skeleton, leaf imprint, invertebrate trapped in amber, or mummified and frozen organisms.
<b>Fossil Record</b>	A term used by paleontologists to refer to the library of fossils that have been discovered, as well as the information derived from them.
<b>Comparative Anatomy</b>	The study of similarities and differences in the anatomy of organisms.
<b>Mass Extinction</b>	The extinction of a large percentage of the earth's species.

## The Specimen

Choose a mammal below to investigate more closely for your research project:

### Extant

- Polar Bear (*Ursus maritimus*)
- Common Zebra (*Equus quagga burchelli*)
- Sumatran tiger (*Panthera tigris sumatrae*)
- Alpaca (*Lama pacos*)
- Pygmy Sperm Whale (*Kogia breviceps*)

### Extinct

- Bone-cracking dog (*Epicyon haydeni*)
- Giant Jaguar (*Panthera atrox*)
- Harlan's Ground Sloth (*Paramylodon harlani*)
- Giant Nebraskan Camel (*Titanotylopus nebrakensis*)
- Large Grazing Horse (*Equus simplicidens*)

## The Project

Using the specimen selected above, collect information about its evolutionary history. You will be orally presenting your research to the class using a digital slide show or poster. There is no set format for your presentation. You are responsible for organizing and presenting the content of your research in a clear and interesting manner, however the questions below and the prompts on the graphic organizer (another page) will help guide you in the kind of information you are looking for:

### Your specimens family tree

- What were the early common ancestors to your specimen?
- What were they like?
- Where did they live?
- How do we know?
- Were/are there descendants of your specimen?
- If they exist, what are they like?
- If they are extinct, why might be the reason(s)?
- What can you compare and contrast about your specimen and it's ancestors or descendants?

### Under pressure

- What was the environment like at the time your animal was alive?
- What other organisms did it live with?
- Did it rely on any of these organisms for survival?
- What relationships to other organisms might your specimen have had?
- Did those relationships change?
- Were there changes in the availability of resources?
- What selection pressures might have influenced the evolution of your specimen?
- What physical changes in the environment, such as changes to the geology and/or climate, might have put pressure on your specimen?
- Why might some traits have been selected for over others?
- What were the advantages and disadvantages of certain traits?

## Research

Explore the Age of Mammals and collect information about your chosen animal and the selection pressures that affected its evolution. You may choose to use the graphic organizer below, as well as the questions on the project page to help guide your research.

What is my specimen's family tree?

What are the notable changes between my specimen and its ancestor and/or descendants? What might have caused those changes?

What was/is my specimens environment like?

What changes in the environment occurred that might have had an impact on my specimen? What was that impact?

How did/does my specimen relate to other organisms?

How did interactions with other organisms change and/or impact your specimen?

## **Research Continued**

Use this space for additional notes and research.