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Journey Through Geologic Time

Hints for Teachers (Middle School and Up)

MUSEUM INFORMATION:

This worksheet is designed to help students practice scientific observation skills in the Beneski Museum of Natural History in conjunction with the classroom curriculum; however, it can also be used independently.

- The Museum does NOT provide copies of *Journey Through Geologic Time*. Please prepare copies for your students.
- While exploring the exhibitions, encourage your students to look above their heads to see specimens displayed at different levels of the Museum.
- The Beneski Museum of Natural History can accommodate up to 45 children and chaperones at a time. Please consider splitting into smaller groups when completing the *Journey Through Geologic Time* activity.
- When your students arrive at the Museum, they will be given a brief greeting by a museum staff member. After this greeting is a good time for you to introduce the activity.

PREPARING AN ACTIVITY:

- *Journey Through Geologic Time* asks students to look critically at specimens to understand the extensive scale of Deep Time and the concept of the Geologic Time Scale.
- The Museum asks that students refrain from leaning on any of the glass cases while working. We recommend providing students with clipboards or notebooks.
- Determine whether you would like students to answer questions in complete sentences; the worksheet does not specify.
- This lesson was designed as an extra-credit assignment; therefore, it can be used for a class assignment or an independent assignment.

IN THE CLASSROOM:

Extend the fun!

- Make sure students have a general idea of what to look at when they arrive. For some of the questions, they will need a basic understanding of animal anatomy.
- Discuss with students the concepts of extinction, mass extinction, climate vs. weather, and genus/species, to prepare them for their *Journey Through Time* scavenger hunt activity.

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Tenets of the Nature of Science

Creativity
The sciences and humanities interact more than most people think. Science is not possible without imagination. In every stage of the process, from idea to experiment, creativity drives inspiration and innovation. Science is also often abstract and thinking outside the box helps us wrap our heads around complex concepts. When science and arts intersect, we achieve the most progress.

Curiosity
Derived from the concept "tentativeness," curiosity describes both the drive for and inherent skepticism of scientific discovery. Scientists are constantly building upon each other's work, using solutions derived by peers to ask new questions. Some generally accepted ideas have lasted for hundreds of years, so it is reasonable to have confidence in their validity, but new innovations are always approached with some apprehension. We are always learning, and there is always more out there. Curiosity keeps us going.

Observation and Inference
Observations involve the five senses. Using physical information, we draw conclusions we can all agree on. Inferences often rely on information not directly available to the senses; we find explanations for what we observe. Science is much more than just a collection of observations; it also requires inferred interpretations.

Scientific Laws and Theories
In science, laws are descriptions of observable phenomena. They are often expressed in empirical terms. Theories, conversely, refer to inferred explanations that have been widely accepted by the scientific community. Laws and theories are importantly distinct from one another and are not interchangeable. They both require substantial supporting evidence but can be adapted in light of new information or discoveries.

Objectivity and Subjectivity
There are infinite factors that can affect a scientist's biases. From institutional affiliation to religious belief, from race to gender, from societal values to personal ones, scientists must always be aware of external influences affecting their practices and conclusions. Though scientists are tentative of new developments and employ measures to hold themselves accountable and improve objectivity (like peer-review), subjectivity can never be fully disregarded.

Empirical Evidence
Empirical Evidence is evidence that can be directly observed and obtained using our senses or through experimental procedure. Some scientific concepts lean toward the theoretical, but they must be rooted in observational or experimental data to be accepted. Challenging existing conceptions is only possible when supported by qualitative or quantitative empirical evidence.

Scientific Methods
Though there are many ways scientists practice their work and develop bodies of information, observations and experiments must be replicable. Scientists must outline their methods so that another scientist could try the same thing and draw the same conclusions. This way, we check each other's work and have more faith in new developments. The scientific method is often viewed as an independent practice, but it is intrinsically collaborative.

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Journey Through Geologic Time

Geologists split up the 4.6 billion years of Earth's existence into the smaller chunks of time we see in the Geologic Time Scale. They decide when each new age starts by looking at changes in the rock record. For example, mass extinctions and changes in climate can act as markers for new geologic ages.

By examining the fossils in the museum, you will learn about the depth of geologic time, when different plants and animals appeared in the rock record, and when mass extinctions took place.

A simplified version of the Geologic Time Scale is on the next page, which will help you complete the activities.

Before you start, review the Tenets of the Nature of Science, and keep them in mind as you complete the activity.

MYA= Million years ago

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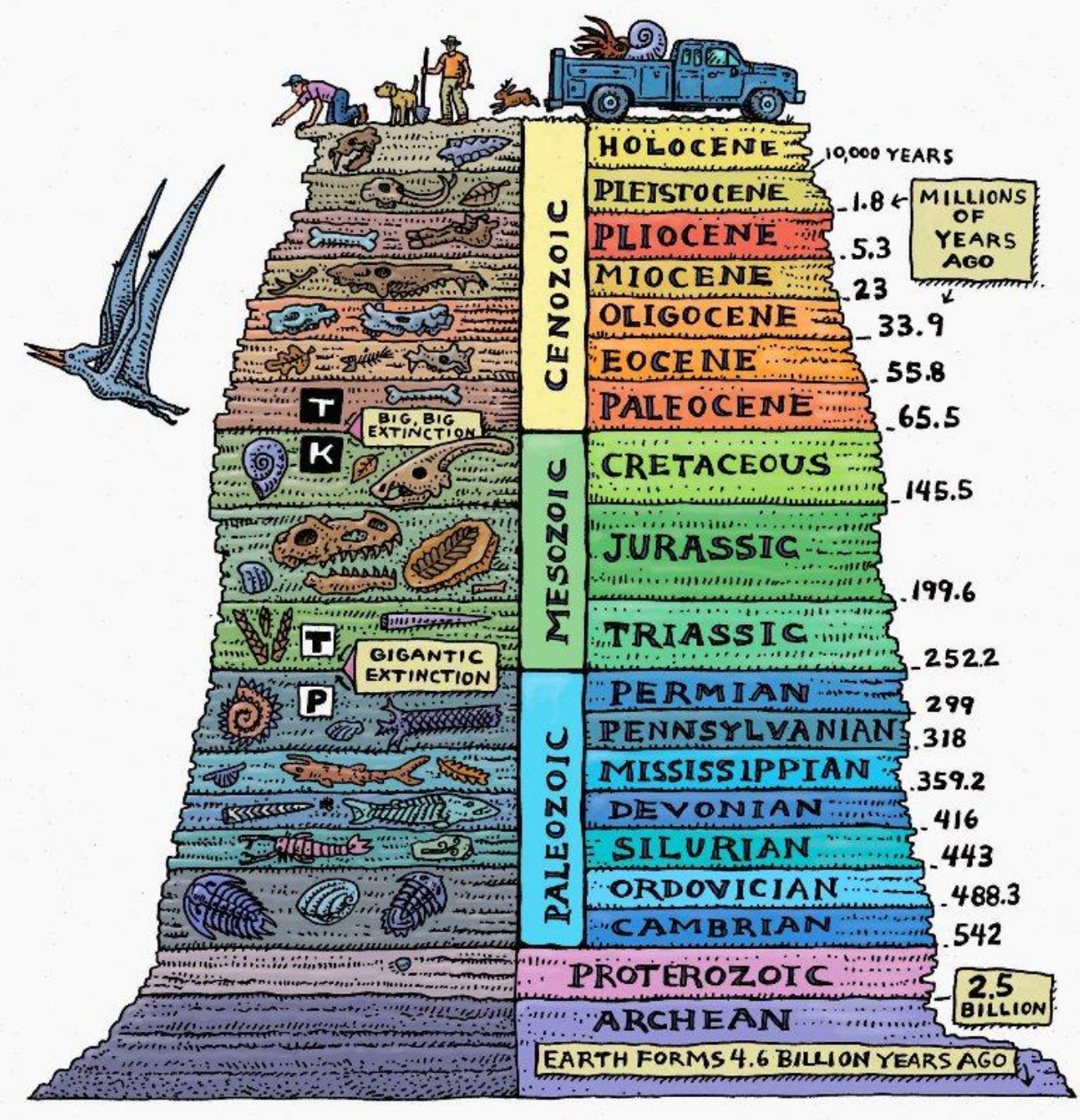
Journey Through Geologic Time

Part 1: Scavenger Hunt



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1. First, head upstairs and find the "Trilobites" drawers. Find a trilobite that is older than 480 MYA. **How old is it? During which geologic time period did it exist?** Refer to the time scale on the previous page.

What is its scientific name?

Genus: _____ Species: _____

The informational panel next to the drawers calls trilobites "Index fossils." **What does this mean?**

2. Next, walk down to the main floor. Some fish fossils don't have jaws; these are called "jawless fish." Other types of fish, like most modern fish we are familiar with, do have jaws. Find a fossil of a fish *with* jaws in either the "Placoderms" or "Acanthodians" drawers. **How old is it? During which geologic time period did it live?**

What is its scientific name?

Genus: _____ Species: _____

During which period did the evolution of jaws occur? Why are jaws advantageous for fish?

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3. Still on the main floor, find an amphibian fossil. Sometimes, these are called "Tetrapods." In these drawers, you will also find modern amphibians, like frogs, but remember, you are looking for a *fossil.* **How old is it? During which geologic time period did it live?**

What is its scientific name?

Genus: _____ Species: _____

What adaptations did tetrapods possess that allowed them to survive on land?

4. Head downstairs and find the oldest complete dinosaur specimen. **How old is it? During which geologic time period did it live?**

What is its scientific name?

Genus: _____ Species: _____

Check out the plaque about the *Diplodicus* legs, located to the right of the fossil you just found. After reading about their ages and where these fossils were found, **can you infer that *Dryosaurus* and *Diplodicus* existed in the same place and time? Why or why not?**

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5. Next, head back to the main floor and find the mammal wall, across from the stairs. Find the Brontothere on the mammal wall. **How old is it? During which geologic time period did it live?**

What is its scientific name?

Genus: _____ Species: _____

Read the plaque to the right of the mammal wall. **What caused Brontotheres to go extinct?**

6. Still on the main floor, find the Mammoth. (Not the mastodon!). **How old is it? During which geologic time period did it live?**

What is its scientific name?

Genus: _____ Species: _____

Mammoths ate around 800 pounds of vegetation per day. **How might a major climate change event have affected the Mammoth's ability to survive?**

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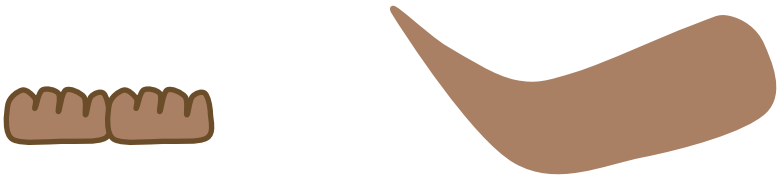
Part 2: Completing a Cross Section

Cross sections are geologic diagrams that view the Earth as if it were cut open and seen from the side. The cross section below shows a cut through a sedimentary rock, with the geologic ages of each rock section labeled for you. Draw, in the cross section below, some fossils you might find in each of the time periods listed. Refer to the geologic time scale on page 3 and your answers to the scavenger hunt activity to get some ideas! The Pleistocene section is done for you as an example. Remember: hard parts like bones and teeth are the parts of an organism that are most commonly preserved as fossils.

	Pleistocene (1.8 MYA-10,000 years ago)
	Cretaceous (145.5-65.5 MYA)
	Jurassic (199.6-145.5 MYA)
	Cambrian (542-488.3 MYA)

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Below, write which fossils you chose to draw in the cross section. Again, the Pleistocene section is filled in for you already.

Pleistocene:
Mastodon teeth, mammoth tusk

Cretaceous:

Jurassic:

Cambrian:

Thinking Questions

1. **How has life on Earth changed (as reflected in the fossil record) during the millions of years that we studied today?**

2. **Millions of years in the future, what do you think geologists would find in the rock record as evidence of human life today? Do you think that we will leave a lot of evidence of our existence in the fossil record? Why or why not?**

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3. Review the definition of **curiosity** provided at the beginning of the worksheet. **Write at least two questions you have after your visit to the Museum and one way you might go about finding the answer.**

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https://www.amherst.edu/museums/naturalhistory