Amherst College

Lessons in Evolution

Hints for Teachers (High School & Beyond)

MUSEUM INFORMATION:

This worksheet is designed to help students explore evolution through the many examples in the Beneski Museum of Natural History.

- The museum does NOT provide copies of *Lessons in Evolution*. 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 students and chaperones at a time. Please consider splitting into smaller groups when completing the *Lessons in Evolution* activity.
- This lesson was designed as an extra-credit assignment; therefore, it can be used as a class assignment or as an independent assignment.
- 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:

- *Lessons in Evolution* asks students to look critically at specimens and think how and why animals evolved.
- The Museum asks that students refrain from leaning on any of the glass cases while working. We recommend providing students with clipboards or notebooks.

IN THE CLASSROOM:

- Make sure students have a basic idea of what to look at when they arrive. For some of the questions they will need an understanding of human and animal anatomy.
- Distinguish whether you would like your students to form complete sentences or not. The worksheet does not specify.
- Discuss noticeable evolutionary traits such as feet to hooves, to give students a more focused look.

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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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Name: _____

At the Ice Age Mammals Exhibit:

1. Observe the skeleton of the Irish Elk (*Megaloceros hibernicus).* **Make a rough sketch of the bones in a human arm and the forelimb of the elk, and then label the homologous structures. Where is the elbow in an elk?**

2. Observe the Mastodon and Mammoth skeletons. **How are they similar and how are they different?** In front of the skeletons, you will find an exhibit of the dentition (teeth) of Elephants, Mastodons, and Mammoths. **Which two species have dentition that is most similar? For those two species, what was their main diet? What was the diet of the one species whose dentition is unlike the other two?**

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3. Read the sign in front of the Cave Bear (*Ursus spelaeus*) and if you need, the *Herbivores and Carnivores* exhibit opposite the Mammoth. Review the definition of **observation and inference** provided at the beginning of the worksheet. **Describe the observations paleontologists make to help them infer the diet of an animal.**

4. At the display of the *Evolution of the Horse* on the main level, note the changes in size, head shape, toe number, and leg bones. **Make a table for each species that illustrates how these features evolved over time.**

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5. On the ground floor you will find a room filled with the largest collection of dinosaur tracks in the US. These tracks are from prehistoric animals that used to walk here in the Connecticut River Valley, and they provide the first evidence of the existence of dinosaurs in North America. Walk through the room and observe the tracks. **What kinds of differences do you see in the shape of the tracks and how the animals walked or ran?** Think about the diversity of the tracks; the feet that look the same but are different sizes. **Could the smaller ones be adolescents? Or could they be a different species entirely? You can describe your observations and inferences in both words and with sketches.**

6. On the top floor, you will find a wall with drawers. Pick any set related to the theme of evolution and speciation in this activity. **Describe what you observe, what facts you have learned from it, and how it ties into the theme of evolution and speciation.**

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7. Pick any exhibit you have not already visited and describe or sketch the exhibit. **Describe what you observe, what facts you have learned from it, and how it ties into the theme of evolution and speciation.**

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9. 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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