Amherst College

Discovering Paleontology

Hints for Teachers (Upper Elementary)

MUSEUM INFORMATION:

This worksheet is designed to help students practice scientific inquiry 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 *Discovering Paleontology*. 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 *Discovering Paleontology* 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:

- *The Discovering Paleontology* activity asks students to look critically at specimens and use their skills in scientific inquiry to hypothesize and visualize extinct creatures of different periods of Earth's past. Students will learn about vertebrates, classifications, extinction, and physical characteristics as well as hypothesize how Ice Age mammals evolved into the animals they are today. Students will examine fossilized evidence of these creatures and learn about the many minerals that make up our world today.
- The Museum asks that students refrain from leaning on any of the glass cases while working. We recommend providing students with clipboards or notebooks.
- *Discovering Paleontology* has a brief set of directions printed at the top for chaperones to use.

IN THE CLASSROOM:

Extend the fun!

- This activity sheet includes questions to create critical thinking. Talk with your class about the different definitions, terms, and topics covered in the activity sheet before your visit.

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Evolution, Speciation & Extinction

Information for Chaperones

COMPLETING THIS ACTIVITY IN THE BENESKI MUSEUM OF NATURAL HISTORY:

- Please allow your students a few minutes to explore the main and bottom floors before beginning the *Discovering Paleontology* activity.
- Consult with other chaperones and assign each group of students a question to begin with, so they start at different sections. This way, not all the students are looking for the same specimen at the same time.
- When the question, "In which vertebrate class does it fit (fish, amphibian, reptile, bird, or mammal)?" comes up, consider encouraging students to have a discussion.
- All specimens can be found on the main, top and bottom floors. Please have students refrain from wandering.
- Remind your students to look all around them, even above their heads.
- Remind your students that the exhibits in the Museum are fragile. Please do not allow them to touch any of the exhibits.

ADDITIONAL INSTRUCTIONS:

- This guide is designed to be completed independently or by small groups of 2-4 children. Younger children with the direct guidance of an adult can also use the guide.
- This activity guide takes the participant through many parts of the Museum. It has been estimated to take up to 2.5 hours to complete every aspect of this activity guide. For grade level groups it is ideal to begin the activities, take a lunch break and return to complete the activities if time permits.
- The guide has been divided into time periods that can be done independent of the whole activity guide. This way the materials can dovetail more effectively with teacher curriculum efforts

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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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Definitions

Dinosaur
A dinosaur is a fossil reptile of the Mesozoic era, often reaching an enormous size. The word "dinosaur" is Greek for "terrible lizard." They first appeared about 237 million years ago (Triassic period) and went extinct about 66 million years ago (Cretaceous period).

Vertebrates
Vertebrates are animals that have a backbone or spinal column, also called vertebrae. These animals include fish, birds, mammals, amphibians, and reptiles.

Fish
A fish is an animal that lives in the water. They have gills that allow them to breathe under water. There are different species of fish. Some may live in fresh water, and some may in salt water. Some examples of fish include trout, the great white shark, and the swordfish.

Amphibians
Amphibians are cold-blooded animals that start their life living in the water with gills like fish. They later develop lungs and can move from the water to dry land. Amphibians include frogs, toads, newts, and salamanders.

Reptiles
Reptiles are cold-blooded animals. They lay eggs and their skin is covered with hard, dry scales. Reptile species include turtles, alligators, crocodiles, lizards, and snakes.

Birds
Birds are animals that have feathers and wings. They lay eggs, and most, but not all, can fly. Some examples of birds include the bald eagle, the ostrich, and the red-tailed hawk.

Mammals
Mammals are warm-blooded animals that give birth to live young. They nurse their young with milk. Mammals have hair or fur. Some examples of mammals include humans, horses, dolphins, dogs and cats.

Carnivores
Carnivores are meat-eating animals. They need sharp nipping incisors, piercing canines, and slicing premolars and molar teeth. They teeth are built to cut through meat like a knife.

Herbivores
Herbivores are plant-eating animals. They generally have large grinding pre-molars to break down and process hard to digest plant materials.

Omnivores
An omnivore is a kind of animal that eats either other animals and/or plants. Some omnivores will hunt and eat their food, like carnivores; some will eat dead matter; and many will eat eggs from other animals. Omnivores eat plants, but not all kinds of plants.

Fossils
Fossils are the remains of ancient animals and plants, the traces or impressions of living things from past geologic ages, or the traces of their activities. Fossils have been found on every continent on Earth.

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Evolution, Speciation, and Extinction

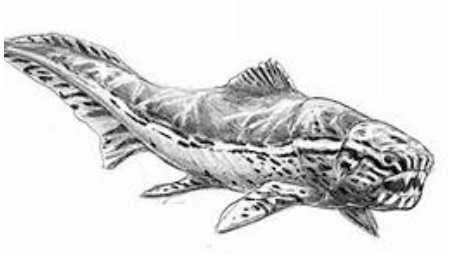
Dinosaurs, Ice Age Mammals, Fossils and More

Name: _____

Section 1: Paleozoic 570-345 MYA

1. Start with the drawers, on your left, as you enter the Museum. Look at the display board, about "Origins of Jaws." Then continue to your right. **In which period did jaws appear in vertebrates? How long ago was that?**

2. Continue more to your right, to the third drawer, labeled, "Chondrichthyans." **What advantages did cartilage fish, with jaws have?**



3. Look in the fourth drawer, to the right of the "Chondrichthyans" drawer, labeled "Acanthodians." **What were some advantages of bony fish?**

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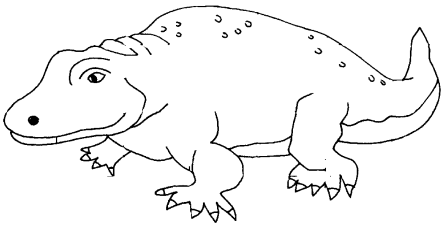
4. Locate the staircase, leading to the upper floor. Locate the "Eryops," upstairs to the left. **In which vertebrate class does it fit (fish, amphibian, reptile, bird, or mammal)? What was the shape of its skull? Draw it below.**

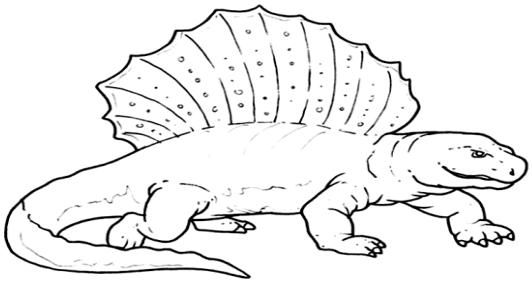


5. **How do scientists know that it spent most of its time in water?**

6. Now, in the same display area as the "Eryops" find the "Edaphosaurus." **In which vertebrate class does it fit (fish, amphibian, reptile, bird or mammal)?**

7. **Review the definition of the word "observation" above. Was the "Edaphosaurus" an herbivore, carnivore or omnivore? How can you tell?**

8. **What do scientists think the sail on its back was used for?**



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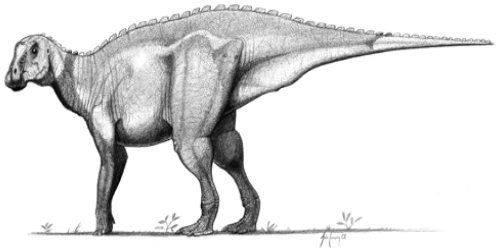
Section 2: Mesozoic 245–65 MYA

1. Now, go back down the stairs, to the entry level. Locate the stairs that lead to the bottom floor of the Museum. You will go slightly to your left, from the bottom of the steps. Find the "Gryposaurus." **What type of dinosaur was this? Why was it sometimes called "duck-billed?"**

2. **Describe how it walked.**



3. Next, locate the "Triceratops," to the left. **Was it a carnivore, herbivore, or omnivore?**

4. **What does the word "Triceratops" mean?**

5. **What were its horns used for?**

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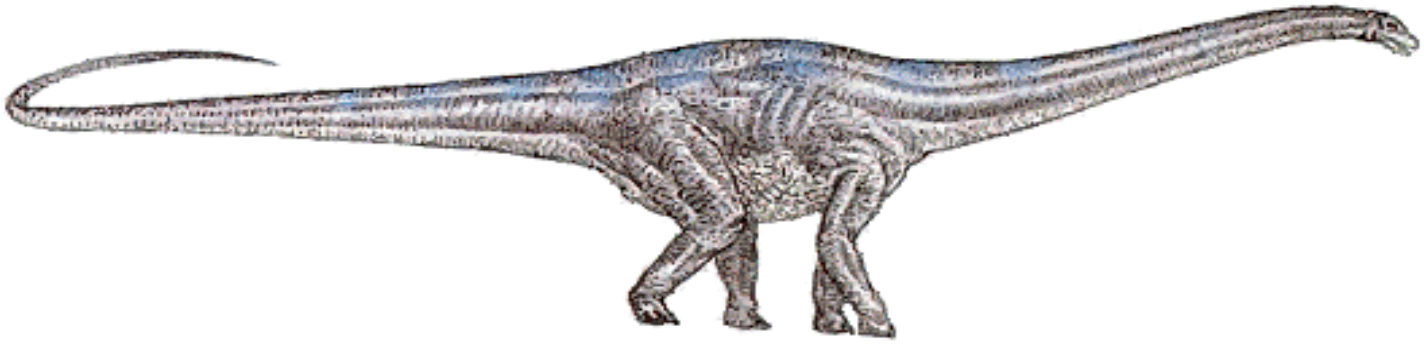
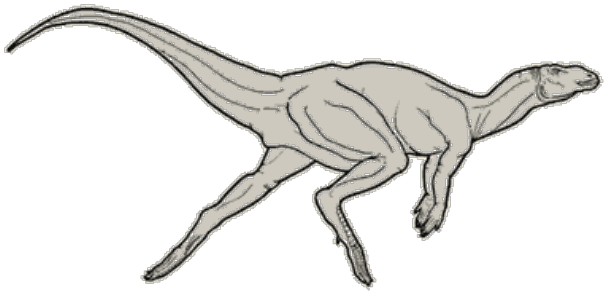


6. Now locate the "Diplodocus longus" limb bones, to your left. **What type of dinosaur was this? During which period did the "Diplodocus longus" live?**

7. **This dinosaur ate rocks, why? What animals do this today?**

8. **What modern animals have limbs like this dinosaur?**

9. Continue to your left. Look at the new exhibit, "Dryosaurus altus." **Describe and/or draw its teeth.**



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10. **What did the "Dryosaurus altus" eat? Was it a carnivore, herbivore, or omnivore?**

11. **During which period did the "Dryosaurus altus" live? How long ago was that?**

12. **What type of dinosaur was it, *Ornithischians or Suarischians*?**

13. **Did the "Dryosaurus altus" have any predators?**

14. **Where was the "Dryosaurus altus" specimen found?**

15. **What other dinosaur specimen on display was found near the "Dryosaurus altus?" Why do you think this was?**

16. Continue to your left and then go straight ahead. Look at the "Tyrannosaurus Rex" skull. **Describe and/or draw its teeth. What did the "T. Rex" eat? Was it a carnivore, herbivore, or omnivore?**

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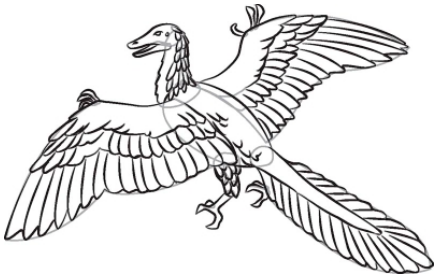
17. **During which period did the "T. Rex" live? How long ago was that?**

18. Go into the room, across from where you are standing. Walk to the right side of the room. The room holds, a collection of dinosaur trackways from the Connecticut Valley found by Edward Hitchcock, who was a geologist, scientist and teacher at Amherst College more than one hundred fifty years ago. Look at these trackways and pay close attention to colors, patterns and textures. **Draw your favorite trackway in this room.**

19. Go back upstairs, to the entry level and look at the sets of drawers on the right, along the back wall. Look for the set of drawers labeled "Limbs and Feathers" (last set of drawers). **What do you see inside these drawers?**



20. **In which period did these vertebrates live?**

21. **What is so special about these vertebrates?**

22. Going to your left look in the drawer labeled, **"**Amniotic Eggs" Locate the **"**Oviraptor Eggs." **Where were they found? In which period?**

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Section 3: Cenozoic 65-2.6 MYA

1. Go to the back wall of the Ice Age gallery. Look at the fossils entitled "Cenezoic Era: Fossil Mammal Wall." Observe them. You may need to stand back a few steps to see them all**Name three of the fossil species seen in this display.**

2. Continue around to your left. Look at the display "Evolution of the Horse." Start at the first display, the "Hyracotherium boreale." **What is another name for this mammal?**

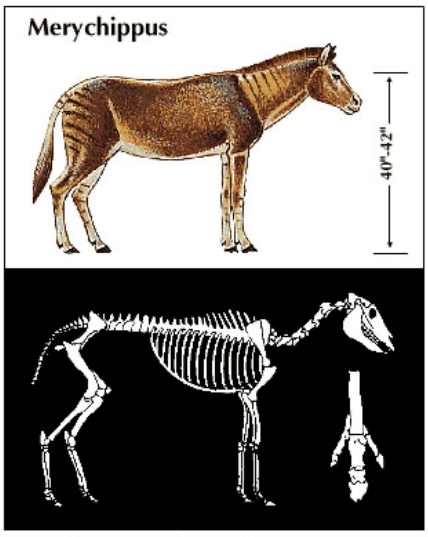
3. **Where and when did it live?**

4. **What did it eat? Was it a carnivore, herbivore or omnivore?**

5. Continue right and observe the "Mesohippus Bairdi." **Where was it found?**

6. **In which period did it live? How long ago was that?**

7. **How was it different from the "Eohippus?"**



Miocene Epoch (26 million years ago)

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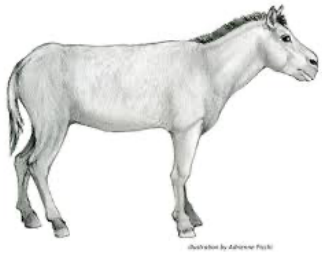
8. Next, find the "Merychippus sejunctus." **In which period did it live?**

9. **How was it different from the "Mesohippus?"**

10. Move on, until you reach the "Equus scotti." **How is it different from the "Mesohippus?"** (Hint: look at the hoof!)



11. Now, stand back and look at all four of these cases at once. **In general, what is the biggest development you notice in the evolution of horses?**

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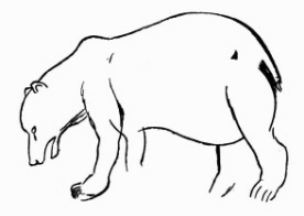
Section 4: Pleistocene 2.6 MYA-18,000

1. Locate the display of Ice Age Mammals by the door where you entered the Museum. Start at the display board entitled, "Environments of Fossil Preservation," located behind the Mammoth. **Name three places where vertebrate fossils are preserved.**

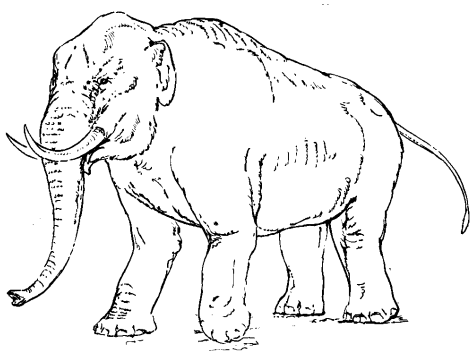
2. Continue to your right and find the "Ursus spelaeus." **What is another name for this mammal?**



3. **Was the "Ursus spelaeus" a carnivore, herbivore or omnivore? How do you know?**

4. Find the "Mastodon" ("Mammut"). **Where did the "Mastodon" originally come from (originate)? When?**

5. **How was it different from the modern elephant?**



6. **What was it covered with?**

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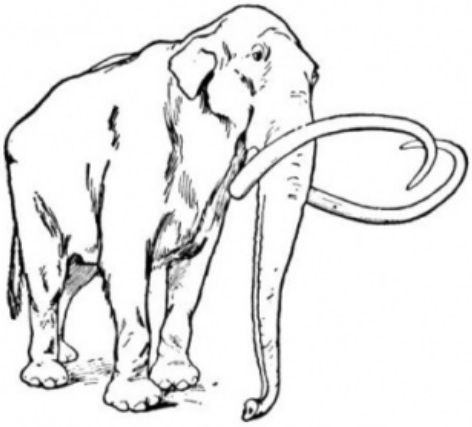
7. **How can scientists tell how old it is?**

8. Find the **"**Megaloceros hibernicus." **What is another name for this mammal?**

9. **Where did these animals live during the Pleistocene Era?**

10. Find the **"**Mammuthus columbi." **What is another name for this mammal?**

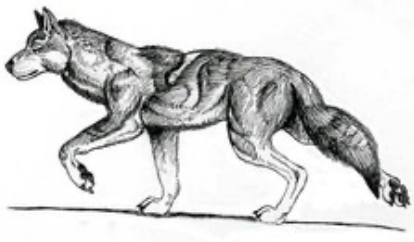
11. **What is special about its tusks?**



12. **Where did these mammals originate?**

13. **Is it an herbivore, carnivore, or omnivore?**

14. Continue to the left, to the "Canis dirus." **What is another name for this mammal?**



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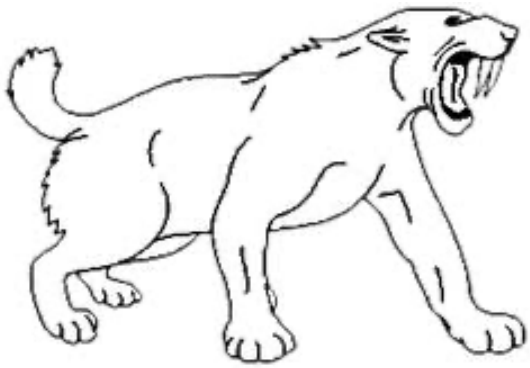
15. **How was it different from the modern "Gray Wolf?"**

16. **What did it eat? Was it a carnivore, herbivore or omnivore?**

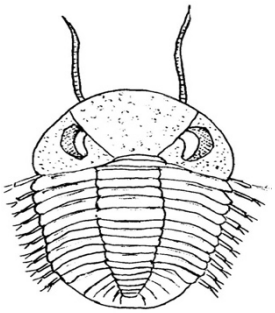
17. Locate the "Smilodon californicus." **What is another name for this mammal?**

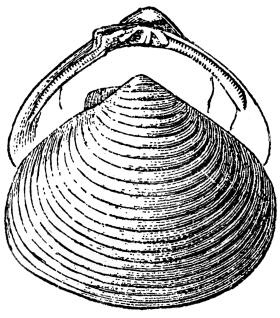
18. **How did it kill its prey?**

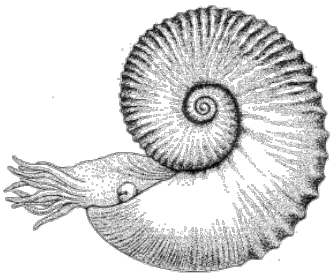


19. **What was its habitat?**

12. If you have time, <u>go back upstairs,</u> and look in the drawers, along the back wall. Inside these drawers, you will find examples of many wonderful fossils. Pay special attention to the ones listed below.







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Trace Fossils

Molds, Casts, and Impressions

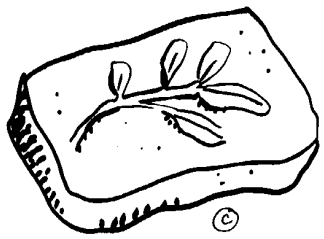
Plant Fossils

Bivalves

Echinoderms

Trilobites

Ammonites and Nautiloids



Which is your favorite and why?

Can you Sketch it?

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- Smith College
- University of Massachusetts
- Williamsburg Schools

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