Amherst College

Plant Fossils

Hints for Teachers (Grade 8 & Beyond)

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 *Plant Fossils*. 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 Plant Fossils 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:

- *Plant Fossils* asks students to look critically at specimens and use their skills in scientific inquiry to hypothesize about the why such fossils persist.
- The Museum asks that students refrain from leaning on any of the glass cases while working. We recommend providing students with clipboards or notebooks.

Acknowledgements

We wish to acknowledge and thank the staff of the following organizations for permitting us to share some of the best lab and field guide materials created for use in the Beneski Museum of Natural History.

- Amherst Public Schools
- Brown University
- Four Rivers Charter School
- Greenfield Community College
- Holyoke Community College
- McAuliffe Regional CPS
- Mount Holyoke College
- Northampton Montessori School
- Northampton Public Schools
- Smith College
- University of Massachusetts
- Williamsburg Schools

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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 floor before beginning the *Plant Fossils* activity.
- Divide into groups and have each group begin with a different question so that not all the students are looking at the same specimen at the same time.
- The "Broad Questions" at the end can be done either before your visit as part of scaffolding, at the end of the visit with museum/teacher guidance, or back at school as follow-up.
- Remember: While in reach of students, remind them that the exhibits in the museum are fragile. Please do not allow them to touch any of the exhibits.

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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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Plant Fossils

Name: _____

Section 1: 2nd Floor

Shallow Inland Seas display (500 MYA)

- *Cryptozoon proliferum* (Stromatolite) ~500MYA
  - Large example on the floor, east wall
  - Cross-section shallow inland sea display

Examine the large stromatolite.

1. **What organisms were responsible for the formation of this large structure?**

2. **Why do they form 'layers?'**

3. **What part could they have played in the endosymbiotic theory, if any?** Review the definitions of **observation and inference** provided at the beginning of the worksheet. **What observations did you use to arrive at this inference?**

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Section 2: 2nd Floor

Plant Drawers (330 – 310 MYA)

Review the definition of **empirical evidence** provided at the beginning of this worksheet.

Set 1

- *Stigmaria* sp. ~330 MYA
  What structures do you think these are? What evidence did you use to arrive at this conclusion?

- *Neuropteris hirsute* ~330 MYA
  What structures do you think these are? What evidence did you use to arrive at this conclusion?

- *Lepidostrobus* sp. ~330 MYA
  What structure do you think this is? What evidence did you use to arrive at this conclusion?

- *Lepidodendron* ~330 MYA
  What tissue/organ is this? What evidence did you use to arrive at this conclusion?

1. **What do you think makes it have that specific kind of texture?**

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Set 2

- *Neuropteris rogersi* ~330 MYA (Early conifer relation)
  Why is this a conifer relative?

- *Calamites* sp. ~310 MYA (Horsetails & spores)
  There are ridges that form a ring around this stem. **What are these ridges? What would for out of them?**

Visit the *Plant Fossil* drawers and locate the large *Lepidodendron* fossil.

2. **Are the leaf-like structures coating the stem of this species microphylls or megaphylls? How do you know?**

3. **Did these plants have vascular tissue? How do you know?**

4. **Did these plants have secondary growth? How do you know?**

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Section 3 - Main Level

Near front door (~310 MYA)

- *Pecopteris distans*
  Fern **(Draw a quick sketch here)**

Section 4 - 2nd Floor

Rifting Display (~200 – 180 MYA) –local fossils

- *Clathropteris platyphylla* ~190 MYA
- *Clathropteris meniscoides* ~190 MYA
- *Pachyphyllum* sp. (Specimen 1, 2, and 3)
- *Vultzia heterophylla* ~190MYA
- *Dendrophycus triassicus* ~190MYA
- *Palissa* sp. ~190 MYA

Examine the painting above the plant fossils found here.

1. **How may have the plants matched to environmental conditions in the Connecticut River Valley some 190 MYA?**

2. **Was the valley in the painting comprised of grasses? If so, why? If not, what plants could have been there?**

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Section 4 - Lower Level

~190 MYA – local fossils

- *Calathropteris* ~190 MYA
  - Fern in sandstone
  - Non-local ~200 MYA
- *Araucarioxylon arizonicun* ~200 MYA
  - Fossilized tree conifer

Examine the diorama here. Carefully read the exhibit display.

1. **Do we still have plants like those of 190 MYA? If not, why not? If so, in what type of environment might they be found?**

2. **What group of plants diversified leaves, and is it evident with the fossils we have seen here today? Why or why not?**

Section 6 – Other 2nd Floor Location

2nd Floor Chemical Replacement Drawers (~170 MYA)

~190 MYA – local fossils

- *Pleurophyllum compton* ~170 MYA
  - Also, 2 pieces of petrified wood (with no date)
    How is petrified wood made? Ask if you cannot find the answer.

2nd Floor Molds and Cast Drawers (~14 MYA)

- *Laurus similis* (Laurel leaf) ~14MYA
- *Ulmus specioca* (Elm leaf) ~14MYA
- *Quercus cognatus* (Oak leaf) ~14MYA

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Section 7 - 1st near Wall of Mammals

(~15MYA)

- *Menziesia knowlton*
- *Quercus payettensis* (Oak)
- *Umbelularia ensis* (Laural)
- *Sequoia langsdorf* (Sequoia)
- *Betula heterophylla* (Birch)
- *Populus heterophylla* (Poplar)

1. **Do any of these look familiar? Why?**

2. **What is a fossil?**

3. **How do they help explain the process of evolution?**

4. **What are three traits plants have evolved since green algae started the course of plants to move onto land? What evidence helps us know this?**

5. **Are plant fossils good environmental indicators of past environments? Why or why not?**