Teacher Guide: Fossil Quest

Concepts:
- Fossils provide important evidence of past species and help us reconstruct the history of life on Earth.

Learning objectives:
- Students will learn what a fossil is and the two basic forms of fossils: body fossils and trace fossils.
- Students will practice distinguishing between different types of fossils in the Hall of Geology & Paleontology.
- Students will practice critical thinking skills in describing whether something is a fossil.

TEKS: Grade 5-7
§112.15, (b)2A, 8B; §112.16, (a)4B, 3A&C, 7D, 10A
Fossilization activities may address: §112.15, 8B; § 112.16 (b)2A-G , §112.18, (b)3A-C

Location: Hall of Geology and Paleontology (1st Floor)

Time: 20 minutes

Supplies:
- Worksheet
- Pencil
- Clipboard

Vocabulary: *body fossil, trace fossil, cast, mold, mineral, sediment*

Pre-Visit:
- Teach a lesson on fossils before visiting the museum. (This is highly recommended as fossilization and the geologic record are difficult concepts for young students to understand.)
- Complete 1 or more of the fossilization activities provided in this packet. We have provided several options, so teachers can choose the activity or activities that best suit the abilities of their students and their classroom budgets.
- Review what a fossil is and the different forms of fossils before coming to the museum. Tell students about the types of fossils they will see at the museum, or have them research the fossils described on our website (tmm.utexas.edu/exhibits/hall-1). Read the next page on background information.

Post-Visit Classroom Activities:
- Conduct a class discussion on what makes something a fossil. Students may want to argue about the example in the Fossil Quest worksheet (is a Giant Clam shell a fossil?).
- Have students write a short research paper (3-5 paragraphs) describing several of their favorite fossils.

Background Information

Fossils are any evidence of past life. They are typically formed within sediment that lithifies (turns to rock) and are at least several thousand years old.

1) **Body Fossil** – originally part of the organism's body (although may have been replaced by minerals)
For example: bones, teeth, tusks, and shells (often hard, calcareous parts)
Soft tissue body parts like eyes, internal organs, muscles, and skin are rarely fossilized.

2) **Trace Fossil** – not originally an organism's body part, but shows evidence of the organism's shape or activity
For example: nests, burrows, footprints or other tracks/trails, coprolites (fossilized feces)

- Molds – impressions in a substrate (such as footprints in mud) or hollow structures
- Casts – form when molds preserving external features fill in with sediment or when hollow shells or bones are filled with sediment or mineral crystals

What can fossils tell us?

- What an organism looked like (morphology)
- Where and when it lived (range and geologic age)
- Its behavior, mode of life, and diet

How many ways can fossilization of a body part occur?

1. **Essentially unaltered preservation** – "actual" preservation of the organism's body parts
    a) Frozen intact (flesh included) – e.g. Wooly Mammoths found in Siberian ice
    b) Trapped in tree resin – e.g. ants in amber
    c) Asphalt impregnation – e.g. skeletons from the La Brea Tar Pits in Los Angeles
    d) Unaltered original skeleton – e.g. calcite exoskeletons of corals, bryozoans, oysters
2. **Alteration by mineralizing solutions (leading to petrification or "turning to stone")**
    a) Replacement – the organism's hard parts dissolve and are replaced by other minerals, like calcite, silica, pyrite, or iron
    b) Permineralization - minerals seep in slowly and fill pore spaces in bone and wood
    c) Recrystallization – the original minerals are changed into more stable mineral forms or small crystals turn into larger crystals
    d) Concretions and nodules – fossils may be preserved inside spherical or elliptical rock bodies
3. **Desiccation –** "mummification" when remains of organisms lose all water
4. **Carbonization** – only carbon remains in the specimen; other volatile elements, like hydrogen, oxygen, and nitrogen are lost in a process called distillation

Fossil Quest

Fossils help us reconstruct the history of life on Earth. Find the following fossils in the Hall of Geology & Paleontology (1st Floor), sketch them, and identify what type they are.

- **Body fossil** – part of the organism's body (usually hard, bony structures like bones and teeth)
- **Trace fossil** – not part of the organism's body, but shows evidence of the organism (footprints and other impressions, burrows)

Fossil name	Sketch the fossil	Body or trace fossil?
***Tyrannosaurus* maxilla (upper jaw bone)** (located between the marine and terrestrial Cretaceous cases)		
Glandular Wahoo leaf (located in the Tertiary case)		
Simpson's Glyptodont carapace and tail armor (located in the Ice Age case)		
Theropod dinosaur track (located in the terrestrial Cretaceous case)		
Columbian Mammoth upper incisor (tusk) (located in the Ice Age case)		

Next, find the jellyfish impressions in sandstone located in the marine Cretaceous case. Why do you think jellyfish fossils are so rare?

TEXAS MEMORIAL MUSEUM

Fossil Quest - KEY

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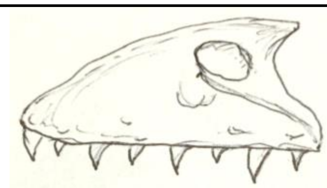
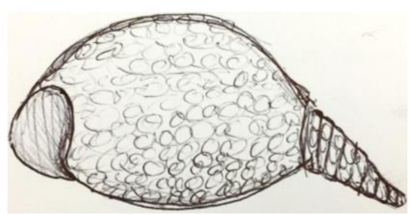
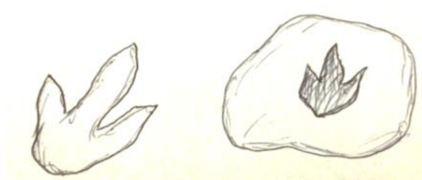
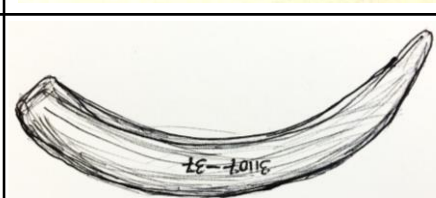
Fossil name	Sketch the fossil	Body or trace fossil?
***Tyrannosaurus* maxilla (jaw bone)** (located between the marine and terrestrial Cretaceous cases)		Body
Glandular Wahoo leaf (located in the Tertiary case)		Trace
Simpson's Glyptodont carapace and tail armor (located in the Ice Age case)		Body
Theropod dinosaur track (located in the terrestrial Cretaceous case)		Trace
Columbian Mammoth upper incisor (tusk) (located in the Ice Age case)		Body

Next, find the jellyfish impressions in sandstone located in the marine marine Cretaceous case. Why do you think jellyfish fossils are so rare?

Jellyfish have no hard parts to become fossilized. The only fossils we have of them are trace fossils.

TEXAS MEMORIAL MUSEUM

Create an Amber Fossil

Explanation: In this activity, students will model a type of **essentially unaltered preservation**. In this example, an organism is preserved intact inside sticky tree resin (not sap) that hardens to form amber (also called fossil resin).

Supplies:

- Resin (can also use clear nail polish for smaller pieces)
- Yellow & red food coloring
- Dead insect (indoor window ledges are good places to collect) OR plastic insect (available in assorted bulk bags)
- Clay

Steps:

1. Roll a fist-sized ball of clay
2. Create a large pebble-shaped mold in your ball of clay either using your fingers or an actual pebble to press down into the clay
3. Mix several drops of yellow food in the resin or nail polish; add 1 drop of red food coloring to make it more amber-colored
4. Fill the mold with a small amount of resin
5. Insert insect
6. Fill the rest of the way with resin and let dry for 24 hours

Note: you can easily turn the fossilized insects into magnets for students to display on their refrigerators at home. Just hot glue a magnet to the back of the resin piece (two magnets may be necessary for larger pieces).

Teachable moments:

- Connection to life science: Clarify with the students that resin and sap are not the same liquids and are produced by different structures in a tree. Not all trees make resin, but all have sap. Sap is the fluid found in phloem and xylem, the tubes that make up the vascular system of the tree. Phloem moves sugars throughout the tree, whereas xylem mainly moves water and minerals. On the other hand, resin is stored in the outer cells of the tree and is produced from wounds as a defense response (much like a clot forms over a wound in humans). Resin is highly viscous and sticky, and can harden to form a protective, watertight covering. Historically, resin has been used as varnish, pitch, turpentine, lamp oil, tar, rosins for string instruments, and perfumes (think frankincense and myrrh). Sometimes, unlucky insects may get stuck in the resin—if they are old enough, they are considered to be "fossilized in amber."
- Review the body parts of insects and their life cycles.

Create a Fossil Mold/Cast

Explanation: In this activity, students will model the process of **mold and cast fossilization** in which the organism's parts are no longer present but have left behind impressions of their internal or external parts (molds), which may be filled by sediments or minerals (casts).

Option 1: Mold

Supplies:

- Plaster of Paris (can also use quick dry cement mix)
- Aluminum foil
- Water
- Popsicle sticks
- Something to fossilize (ex: shells, sea stars, dinosaur foot imitations, fish bones)

Steps:

1. Create a shallow bowl shape with the aluminum foil
2. Mix plaster and water with a popsicle stick in the aluminum foil bowl (Warning: if you use quick dry cement, it will get hot!)
3. Press the fossil material (shells, etc.) into the surface (Note: if pressed too far, they can be very difficult to pry out!)
4. Let plaster harden, and then remove fossil and aluminum foil

Option 2: Cast

Additional Supplies:

- Clay
- Small plastic or paper cups

Steps:

1. Start with a lump of clay inside a small cup (instead of plaster), and complete the steps for a mold.
2. In another small cup, mix the plaster and water with the popsicle stick. **Quickly** pour it into the clay mold. (The reason to do this quickly is that when the plaster hardens, it won't fill in the fine details of the mold. Alternatively, you can pour the plaster powder into the mold, then add water directly.)
3. Wait for the plaster to harden, then tear away the cup around it and gently remove the clay.

Create a Fossil Mold/Cast

Teachable moments:

- Emphasize the importance of a moldable substrate. Here we used manufactured plaster (made from the naturally-occurring mineral gypsum), but in real life, prints would be made in mud, ash, or the soft seafloor. If a dinosaur walked across hard rock, such as granite, no imprint would be made.
- Ask students to explain the relationship between molds and casts. The processes in nature are similar to the ones in the activity. For example, an ocean animal dies and sinks to the bottom of the sea, where it is then buried quickly by sediment. Over time, its body deteriorates and eventually dissolves away completely; this can leave an empty space in the sediment in the shape of the organism (a natural mold). Then, water circulating through the sediment leaves behind minerals such as silica, filling in the mold and creating a cast. Later, the cast may be unearthed by natural geological processes, or by human activities (often construction work, rarely archeological digs).

Modeling Petrified Wood

Explanation: In this activity, students will model the processes of petrification, when organic material is replaced by minerals.

Certain conditions are necessary for wood to become petrified in Nature, but it is not as uncommon as we might think. First, a tree must be sealed from oxygen to prevent decay. If it is not sealed, bacteria and fungi will usually decompose the wood. This seal may be created in a variety of ways. A flood which deposits sand and silt may suddenly bury a tree that has fallen to the forest floor. It may also be buried by volcanic ash or a lava flow from a nearby volcanic eruption.

Next, there must be minerals present that will cause petrification. Examples include calcite, pyrite ("fool's gold"), marcasite, and silica, which is the most common. These minerals dissolve in groundwater, seep through the sediment covering the wood, fill the spaces within the wood and replace organic material. Through chemical processes, the minerals move from the water and into the individual plant cells. In good examples of petrification, you can still see the cell walls if you look closely enough.

Supplies:
- Twigs or sticks, small enough to fit in the cups
- Large plastic cups
- Sand
- Water
- Food coloring

Steps:

1. Fill a cup ¼ full with sand and place one or two pieces of wood in the cup on top of the sand.
2. Pour sand over the wood until it is completely covered. (Your cup will probably be about ½ full).
3. Get a second cup, and fill it ½ full with water. Choose a color from the food coloring. Add drops of food coloring until the desired shade is reached. About 10 drops are recommended.
4. Slowly pour the colored water into the cup with the sand and wood pieces. Pour just a little at a time, and watch it seep to the bottom each time.
5. Continue to add colored water until the sand is completely and evenly saturated and a little water covers the sand. It is best to have only about ½ cm of water on the surface of the sand. You do not have to use all of the colored water; only use what you need.
6. Be sure that the wood is still buried after you pour the water in the cup. If not, push the wood under the surface of the sand with the stirring rod or a popsicle stick.
7. Cover the cup with plastic wrap and place a rubber band around the outside. The rubber band and plastic wrap should fit tightly around the cup.
8. After 1 week, uncover the experiment and observe changes that have taken place in the various pieces of wood.

Modeling Petrified Wood

Teachable Moments

- Before performing the activity, have students predict what their results will be and record their predictions and observations in a Scientist Notebook (see next page)
- During each step of the activity, discuss the natural processes that it is modeling. This is especially important for the connection between the food dye and the silica—both must be dissolved in water.
- Turn the activity into an experiment by having students manipulate variables to see what changes. For example: time of burial, clay instead of sand, water temperature, old chicken bone instead of wood, salinity of water, piece of plastic instead of wood, a different type of sand or dirt. Ask students what these changes tell us about the best environments for fossilization.

Scientist Notebook

Before the experiment
Write down your hypothesis, or what you think will happen.

After the experiment
What physical characteristics of the wood have changed? How did these changes occur?

What part of natural petrification does the food coloring represent in this experiment?

Why were the cups covered with plastic wrap and a rubber band?

How would real petrified wood be different from the petrified wood that you created in the experiment? Why?

Explain the importance of the presence of water for petrification to occur.