Day 03 How Do Fossils Form?			
Literacy Strategy: practice skimming and scanning for specific information.		**Science Concept:** fossilization of organisms occurs in many different ways.	
Reading TEKS: 3.9(D&F), 3.13(C)	**CCSS:** RI.3.5, W.3.7, W.3.8	**NGSS:** 3-LS4-1	**Science TEKS:** 3(b)(1)(A)
Materials for Mini-lesson on Science-Based Disciplinary Literacies (referred to as Mini-lesson): chart paper, markers, sample inquiry chart.			
Materials for Science Inquiry Circles: team inquiry charts, pencils, variety of nonfiction texts for each group, access to websites and online books, access to anchor charts already introduced.			
Materials for Guided Science Investigation: see instructions beginning on page 3.			
Content Vocabulary: **Observation—**the action or process of looking at something or someone carefully to gather information. **Organisms**—living things that are able to carry on the functions (actions) needed to live, grow, and survive. **Fossil**—the preserved remains or traces of organisms found in the layers of the Earth. **Body fossil**—the fossilized remains of parts of an organism's body, such as shells or bones. **Trace fossil**—records of the activities or behaviors of past life, such as nests, footprints, or scat. **Sedimentary rocks**—a type of rock, formed by layers of sediments, where fossils are usually found.			
Science and Literacy Connection: Scientists do a lot of reading as they expand their knowledge about a topic they are investigating. Being able to efficiently find the specific information they need is important.			

Mini-lesson—15 minutes

OVERVIEW

Today's mini-lesson should be used to review and practice the reading strategy introduced yesterday: skimming and scanning for specific information. Teachers are encouraged to use this time to best meet the needs of their learners.

Teachers can determine if the mini-lesson will be facilitated with the whole class or with a particular inquiry circle that needs additional support. If you are working with a specific team, we suggest your other learners spend additional time working in inquiry circles.

You may want to return to the information in the mini-lesson from Day 2 with some or all of your teams.

Science Inquiry Circles—30 minutes

OVERVIEW

Scientists often work in teams when conducting inquiry and investigations. Today, we will work in inquiry circles to investigate different questions about plant groups. It is important to note that the inquiry circles are focused on the four major plant groups (mosses, ferns, conifers, and flowering plants) because learners will also be examining representatives from each group during the science investigations. Since it is not possible to observe all of the members of a large group firsthand, scientists must turn to text resources to expand their knowledge.

Prior to starting the inquiry circle work, be sure to have texts and technology available for your learners. You have been provided with a list of suggested books and websites titled Plant Resources in the Day 3 folder. These are suggestions, and you may use other resources. You may need to provide learners with specific instructions on how to access websites within your school district or you may want to create a click sheet of approved websites for learners to be distributed in your learning management system (Google Classroom, Schoology, etc.). As teams begin working, you may have some groups working online while others are working with traditional texts. This will depend on your access to technology and texts.

PROCEDURE

Each statement in quotation marks below contains suggested wording the teacher may choose to use for the lesson; teacher actions in parentheses.

Before Inquiry Circles

1. "It is time to get into our inquiry circles. You will be with the same team as yesterday, but we will rotate the scientific roles." (Assign roles at your discretion and have the Equipment Directors gather the inquiry chart for their team).
2. "Yesterday we became familiar with the inquiry chart and the inquiry questions. We also recorded what we already know about the plant group (mosses, ferns, conifers, or flowering plants). Today we will begin to look for answers to all of your questions."
3. "As you look for answers to your questions, you will practice your roles as scientists. You will do this because scientists have a special way in which they look for answers. One way to look for answers is to do investigations. This means that they look at text (in books and on the computer) that might help them find information they can use."

During Inquiry Circles—20 minutes

4. "Today and for the next few days, you will investigate your plant group by using preselected websites on the computer (or tablet) and preselected texts." (The websites and texts are available in the Plant Resources document.)
5. "We have anchor charts to help guide your thinking. Do not forget to use them while working." (Refer to the Inquiry Toolbox anchor chart and the Skimming and Scanning for Specific Information anchor chart. Remind learners that, each day, they will practice the literacy mini-lesson during this inquiry circle time. Once you have taught several mini-lessons, they can use any of the reading strategies taught, not just the one for that day.)

6. “The Lead Scientist will guide all inquiries for the day by picking which question(s) will be answered. The Data Scientist will record all source information and the answers to your inquiry questions on the inquiry chart. Remember, it is important to record on your inquiry chart where you found the information (source) so that you do not plagiarize.” (Point out to learners where sources are located on the inquiry chart and how one source may answer various questions. Remind your learners to record the title and author for texts and the URL for websites.) “The Lab Director and the Equipment Director must help find the answers to the questions online and in texts.” (Be sure to model for learners where to record their source and where to record answers to specific questions. Explicitly show them how the inquiry chart will organize their progress.)
7. “My role is to help guide the inquiry circles, but I expect you to work as a scientific team to solve your problems together.” (While teams are working together, walk around the room to facilitate as needed.)

After Inquiry Circles—10 minutes

8. “As we conclude our inquiry circles for today, each team will have a chance to share the information they found related to their questions, what they accomplished, and what literacy strategies they used. The Lab Director will lead the discussion about today’s results, and the Data Scientist will share your responses with the class. Discuss with your team, considering what you learned about your plant group. What problems did you encounter? How did you resolve those problems? Did you use a reading strategy? Which one and how did it help you? What new questions do you have?” (After you have allowed the teams to gather their thoughts, have the Data Scientist share with the class.)
9. (After all learners have shared, thank them for their hard work, and point out any excellent behaviors that you observed. If you saw an outstanding example of using a reading strategy or collaborative work, explicitly point it out. If you notice any problems in the teams during the lessons, take a moment to point them out, and explain your expectations for all future inquiry circles. Collect all inquiry charts or have learners put them in their normal classroom place for ongoing work so they can easily access them.)

Guided Science Investigation—30 to 45 minutes

OVERVIEW

Children finish their excavation work today with a discussion of their findings then view a slideshow to learn about different types of fossils and how they are formed.

GUIDING QUESTIONS

What information does our fossil give us? What are some of the ways that organisms can become fossils?

BACKGROUND INFORMATION

Rock structures called stromatolites contain the oldest-known fossil organisms. Stromatolites were formed by colonies of photosynthesizing cyanobacteria that covered shallow water in an early, hot Earth environment billions of years ago! Cyanobacteria are one type of living fossils that can still be found on Earth.

Fossils are typically found in sedimentary rocks. Sedimentary rocks form through the geologic processes of weathering, erosion, deposition, compaction, and burial. Over time, the remains of plants and animals are preserved through physical, chemical, and biological processes called fossilization. Sometimes, fossilization occurs when the plants and animals are covered by soil sediments before they decay. Physical and chemical changes turn sediments into lithified rock (rock that is formed when sediments are compressed over time). Sedimentary layers and their fossil contents provide scientists with evidence of past climates and changes in the Earth's crust over time.

There are many different ways that organisms can become fossilized. Permineralization is the most common form of fossilization and occurs when water from the ground or a body of water ***deposits*** minerals, typically silica, into the empty spaces (or pores) of bones, wood fragments, or shells. Petrified wood, fossilized dinosaur bones, and many marine fossils were formed as a result of permineralization in a process called petrification, when organic material is ***replaced*** by minerals and it turns to stone.

Impressions are imprints that do not contain any organic material. They give us important information about how an organism lived. Trace fossils are examples of impressions and include tracks, burrows, and scat that can provide information about an organism's behaviors. Trace fossils are formed in place and can give us clues about the environment in which the organism lived. Plant fossil impressions can be found in fine-grained sediments such as clays or silts (clays and silts are soil types with very small particle sizes).

Mold and cast fossils are formed from the remains or hard parts of a plant or animal, like a bone or stem. Mold fossils are the detailed holes or cavities left in Earth materials (like mud or sandstone) by an organism after it decays or rots away. In time, that cavity becomes rock. If that mold (cavity) is filled with another material such as sand or groundwater, it becomes a cast of the original hard parts of the organism.

And then there is amber, the sticky tree resin that traps small organisms like insects or seeds, preserving ancient life as fossils for millions of years!

SAFETY

Children should wear safety goggles.

MATERIALS

Each team member will need:

- science notebook
- goggles

Each team will need:

- team fossil "dig"
- paper grid map from Day 1
- paper plates with fossil pieces

Teacher will need:

- Fossils PPT in the Day 3 folder

SETUP

- Prepare to project Fossils PPT after student presentations.

DAILY OBSERVATIONS

There are no observations at this time.

PROCEDURE

Engage

1. Ask, *Are paleobotanists ready to share what they found in their fossil dig?*
2. Instruct the teams to collect their plates with the fossils and their grid maps. Tell them that the team Data Scientist will give a short explanation on the excavation using the paper grid map. Then, team members can show the fossil they unearthed, explaining what it is and describing what they see (leaves, stems, seeds, etc.).

Explore

3. As teams present their findings, encourage other teams to ask them questions about their work.
4. Teams may have missing parts to their fossil. Listen for their reasoning as to why that is (only excavated 4 out of 6 sites, pieces broken too small, unable to find or reconstruct?). Share that this happens in real-life excavations too!
5. After all teams have had a chance to present, congratulate them on their work! Remind them that the previous day's fossil exploration was a simplified example of how paleobotanists, excavate and reconstruct fossils. Reveal that every minute they worked in class could be translated into months or even years that are actually spent on a "dig"!
6. Ask Lab Directors to collect and return all materials to the designated area. Then say, *Let's learn more about fossils!*

Explain

7. **Begin the slideshow.**
   Slide 1 (image of the baby woolly mammoth): Ask, *Does this look like a fossil to you?* Accept responses. Explain that fossils form in many different ways. Share that this is indeed a fossil. It is a one-month-old female woolly mammoth that was found frozen in Siberia, Russia. Her name is Lyuba (Lew bah), which is Russian for love, and she is about 42,000 years old! Add that she is the most complete mammoth ever found and that she had preserved soft-body parts. Using technology, scientists found fine sediments in her airways and determined that she had choked to death after she became trapped in muddy sediments. She remained frozen in the soil (permafrost) along the banks of a river until she was discovered in 2007 by Siberian reindeer herders. Inform the class that finding large specimens frozen in time like Lyuba are rare.
8. **Slide 2** (image of Antarctica): Ask, *Do you suppose a frozen continent like Antarctica pictured here might have hidden fossils under the ice?* Accept responses. Reveal that fossils are abundant in Antarctica—most of them from plants! Leaves and wood are evidence of fossil forests buried under the ice for millions of years! Some of the first specimens were discovered in the 1800s, and today scientists are still uncovering and studying new plant fossils.
9. **Slide 3** (amber image): Ask, *Who can tell me what this is?* Accept responses. (Children may be familiar with amber.) Confirm that this is amber—fossilized, sticky tree resin. Point out the plant parts seen in the amber and explain that small organisms like insects and plant parts became trapped in the tree resin before it hardened. The hardened resin has been preserved for millions of years!

10. **Slide 4:** Ask, *What do you think are the oldest fossils that have been found so far?* Accept responses.
11. **Slide 5** (cyanobacteria): Reveal that the oldest known fossils are tiny cyanobacteria that lived on Earth billions of years ago! Although they are bacteria, they are photosynthetic, which means they can make their own food like plants do.
12. **Slide 6 (**stromatolites): Ask, *How do we know cyanobacteria was on Earth so long ago?* Rocks! The fossils of organisms, both plant and animal, found in rocks gives us evidence of the types of organisms that lived long ago. It also offers clues about their behaviors and helps us to understand the types of environments they lived in. Rock formations called stromatolites provide the oldest fossils on Earth! Cyanobacteria covered the landscape of Earth in shallow waters at a time when Earth was really hot, volcanoes were everywhere, the atmosphere had toxic gases, and there was constant rain.
13. **Slide 7** (algae/ferns): S*o, what are living fossils?* Cyanobacteria are considered *living fossils* because they have been on Earth for billions of years and some exist even now. Although they are photosynthetic and can make their own food, they are not considered plants. There are many other living fossils we can find on Earth today, including algae and ferns.
14. **Slide 8** (body fossils): Body fossils are typically the remains of an organism's body, such as shells or bones.
15. **Slide 9** (coprolite): Ask, *What kind of information can a trace fossil give us?* Trace fossils include burrows, footprints, and even poo! Fossilized poo is called coprolite. Trace fossils are important because they give clues about the organism's presence and behaviors.
16. **Slide 10** (microfossils): Ask, *What are the smallest fossils?* The smallest fossils measure less than 1 mm (about the size of a pinhead!) and can only be seen through a light or electron microscope. Microfossils are very abundant on earth and include fungi, pollen and spores from plants, and microscopic animals.
17. **Slide 11** (text only): *So where do we find fossils?* Accept responses.
18. **Slide 12** (sedimentary layers): Explain that not all organisms become fossils, but those that do are found in sedimentary rock. Ask, *How so?*
19. **Slide 13:** (Explain the sedimentary process using the next two slides):
    - Large rocks are broken down into smaller pieces by a process called weathering, caused by water, wind, ice, heat, and living things.
    - The broken pieces of rock are transported by water, wind, ice, and gravity to settle on the bottoms of bodies of water. The larger pieces drop out into rivers or streams, and the smaller pieces, called sediments, continue further into the oceans.
    - When organisms die in a body of water, they may be buried in a layer of sediments before they rot.
20. **Slide 14:**
    - Over time, layers of sediments build up on top of each other and the weight of them press down, or compress, the layers and any organisms in them.
    - Dissolved minerals in the water fill up tiny spaces in the organism.
    - Pressure from the layers on top, chemical reactions from the dissolved minerals, and time turn the sediments into rock, and the organisms may become a fossil. They remain in the rock until the layers are eroded or excavated.
21. After the slideshow, ask students to share what they have learned about fossils. Ask if they have any questions or need any information clarified. Ask, *What do you think happens to any organisms that end up in these sedimentary layers?*

Elaborate

22. Announce to the class that tomorrow they will have a chance to simulate how fossils are formed by exploring two kinds of fossils: casts and molds.

Evaluate

23. Did learners communicate prior or new knowledge about fossils or the sedimentation process?
24. Did learners raise new questions about fossils or the sedimentation process?
25. Did learners include new science vocabulary in their responses or explanations?

Expanded Standards
Reading TEKS: 3.9 Multiple genres: listening, speaking, reading, writing, and thinking using multiple texts—genres. The learner recognizes and analyzes genre-specific characteristics, structures, and purposes within and across increasingly complex traditional, contemporary, classical, and diverse texts. The learner is expected to (D) recognize characteristics and structures of informational text, including (ii) features such as sections, tables, graphs, timelines, bullets, numbers, and bold and italicized font to support understanding; and (F) recognize characteristics of multimodal and digital texts. 3.13 Inquiry and Research: listening, speaking, reading, writing, and thinking using multiple texts. The learner engages in both short-term and sustained recursive inquiry processes for a variety of purposes. The learner is expected to (C) identify and gather relevant information from a variety of sources.
CCSS: RI.3.5 Use text features and search tools (e.g., key words, sidebars, hyperlinks) to locate information relevant to a given topic efficiently. W.3.7 Conduct short research projects that build knowledge about a topic. W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
NGSS: 3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived.
Science TEKS: 3(b)(1)(A) Scientific investigation and reasoning. The learner conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate practices. The learner is expected to demonstrate safe practices as described in Texas Education Agency-approved safety standards during classroom and outdoor investigations using safety equipment as appropriate, including safety goggles or chemical splash goggles, as appropriate, and gloves.