

Fossils

Scope Planning and Overview



Scope Overview



In this instructional unit, students delve into the processes of fossilization and the paleontological methods used to infer past environmental and biological conditions. Through creating and analyzing fossil imprints, they experiment with various materials to understand how fossils preserve historical data and simulate paleontological digs to determine the age and context of fossils. This hands-on approach not only enhances their understanding of how fossils inform us about ancient life and environments but also hones their skills in obtaining, evaluating, and communicating scientific information effectively.

Student Wondering of Phenomenon

What do fossils tell us about the past of an environment?

Student Expectations

The student will–

- obtain, evaluate, and communicate information about what a fossil is and ways a fossil can provide information about the past, such as a) the nature of environments and b) animals that existed long ago but no longer exist.

Scope Vocabulary



The terms below and their definitions can be found in Picture Vocabulary and are embedded in context throughout the scope.

Environment

The space, conditions, and all the living and nonliving things around an organism

Evidence

Information that supports an idea

Fossil

A preserved part or trace of an animal or plant that lived in the past

Organism

A single, self-contained, living thing

Existence

Survival; continued living

Extinction

The permanent disappearance of a species from Earth

Notes



Home



Engage



Explore



Explain



Elaborate



Evaluate



Intervention



Acceleration



Engage Activity Summaries

APK

Accessing Prior Knowledge:

In this activity, students engage in a “Four Corners” discussion to explore and express their understanding of what fossils reveal about past life. They choose one of four images, each suggesting a different interpretation of fossil evidence, and discuss why they selected it. This interactive approach aims to identify and address misconceptions about fossils, such as their role in explaining the presence of ancient organisms rather than geological formations like canyons.

SP

Scope Phenomenon

In this activity, students watch a video about a fish fossil to understand fossils and their role in revealing historical data. After viewing, they answer questions independently, discuss their findings, and speculate further with “I wonder...” notes. This method helps them think about why certain fossils, like seashells, are found in unlikely places like deserts, enhancing their grasp of paleontology and the historical shifts in Earth’s landscapes.



Explore Activity Summaries

Explore 1

Activity - Nature of Science

In this hands-on activity, students create fossil imprints using various materials to explore how fossils form. They use clay, gravel, and sand to press and then uncover imprints of objects, comparing which soil type best preserves the fossil details. The activity is designed to simulate real-world fossilization processes and help students understand the factors affecting fossil preservation, illustrating the challenges paleontologists face in studying ancient life.

Explore 2

Engineering Solution - Fossil Dig

Students analyze fossil cards to determine the corresponding organism and environmental context, simulating a paleontological dig. Groups differentiate fossils found at various depths, constructing a poster to illustrate the environmental transitions over time based on stratigraphic layers. They then present their findings, explaining changes in the environment and evolutionary adaptations of organisms, and answer questions to deepen understanding of paleontological evidence and historical ecological shifts.

Notes



Fossils

Accessing Prior Knowledge

Activity Preparation



Students will dialogue with classmates about their understanding of how fossils are evidence of past organisms through a four corners discussion. This element is designed to uncover student misconceptions. It should not be taken for a grade.

Materials

Activity Files

- 1 Four Corners Images (per teacher)

Reusable

- None

Consumable

- None

Preparation

- If not assigning the Accessing Prior Knowledge digitally, print one set of the Four Corners Images.
- Hang the images in four separate areas of the classroom, easily visible to all.

Procedure and Facilitation



ACTIVITY TIP

Consider reading sentences and allowing the class to observe images prior to hanging them in corners. This can allow for students to through what they notice about each image before deciding which corner to move to.

Activity

1. Ask the students to look at the four corners and think about which corner image best explains what fossils can tell us about the past.
2. Allow 2 minutes of thinking time.
3. Ask students to move to the corner image they chose. Ask each group to discuss with each other why they chose the image.
4. Allow 2–5 minutes of discussion at the corner images.

Identifying Misconceptions

Accessing Prior Knowledge activities help you identify possible student misconceptions. The following misconceptions may be revealed during this APK. These misconceptions will be addressed as students move through the scope and do not need to be clarified at this point.

- Image 1: A canyon is shown with the sentence, “Fossils tell us how landforms like a canyon formed.” If students choose this corner, they may need more instruction on what fossils are and how fossils do not provide information about the development of landforms.
- Image 2: A dinosaur fossil is shown with the sentence, “Fossils tell us that the only fossils are from dinosaurs.” If students choose this corner, they may need more instruction on how fossils are evidence of any past organism, including plants.
- Image 3: A fern imprint is shown with the sentence, “Fossils tell us what kinds of plants lived in an environment.” If students choose this corner, they may need more instruction on how fossils can be both animals and plants.



Home



Engage



Explore



Explain



Elaborate



Evaluate



Intervention



Acceleration

- Image 4: This is the correct answer. Different layers of Earth are shown with the sentence, "Fossils can tell us if an environment changed over time." If students choose this corner, they understand that the type of fossils that are found in a certain area can help us compare the current environment in that area to what the environment must have been like before to support the kinds of organisms that are found there in fossil form. For example, if a fossil of a marine organism is found on a mountain, it means that the area was once covered by a large body of water.
- The English language has many words with multiple meanings. To eliminate any confusion, ensure students have an understanding of the following words.

Word	Possible Student Thinking	Our Intention	In Context
Plant	To place in the ground; to stay in place	A type of living thing that gets its energy from the Sun and is unable to move from place to place on its own	The plant needs sunlight and water.

Notes



Fossils

Scope Phenomenon

Activity Preparation



Students will watch a video of a fossil of a fish to learn about what a fossil is and how a fossil can provide information about the past. Students should build on their knowledge and understanding of the phenomenon as they move through the different activities in this scope.

Materials

Printed Material

- 1 Student Handout: Fish Fossil (per student)

Reusable

- None

Consumable

- None

Preparation

- If not assigning the activity digitally, print one Student Handout per student.
- Prepare to project the Student Handout.
- Brainstorm additional questions you may want to discuss beyond the Student Handout during the activity.

Procedure and Facilitation



ACTIVITY TIP

Students may make connections to fossils as they relate to dinosaurs. Ask students to think about what the environment of dinosaurs may have looked like long ago.

DIFFERENTIATION TIP

If students are struggling to create wonderings, ask them to use who, what, when, where, why or how after the "I wonder..." sentence starter. This can encourage them to think a little deeper about the phenomenon.

Activity

1. Distribute the Student Handouts.
2. Show students the video.
3. Instruct students to read each question on the Student Handout and independently answer the questions.
4. After all students have answered the questions, discuss as a class.
5. To wrap up the activity, give each student a note card or sticky note.
6. Have students use the note cards or sticky notes to finish this sentence stem:
 - I wonder...
7. Collect the sentence stems to identify class questions.
8. Use the questions to spur interest throughout the scope.
9. Introduce students to the Student Wondering of Phenomenon question below:
 - What do fossils tell us about the past of an environment?
10. Let students know that, as they move through the scope, they will be doing a number of activities to help them answer the Student Wondering of Phenomenon question and to learn the information that is needed to describe the events in the Scope Phenomenon.
11. When the scope is completed, have students look back at the Scope Phenomenon. As you lead them in answering the question, encourage them to use the information that they learned throughout the scope.

Notes



Fossils

Explore 1: Activity - Nature of Science

Activity Preparation



Timestamp: 1–2 hr.

Students will examine how fossils are created by making their own models.

Materials

Printed

- 1 Student Handout: Nature of Science (per student)

Reusable

- 1 Set of objects to make imprints, such as plastic animals, artificial leaves, cleaned chicken bones, etc. (per group)
- 3 Spoons (per group)
- 1 Digital camera or device with picture-taking ability (per class)

Consumable

- 1 c. Flour (per group)
- 1 Paper plate (per group)
- 10–12 Paper towels (per group)
- 2 Clear plastic cups (per group)
- 3 Small cups (per group)
- 1 Container of modeling clay (per group)
- 1 c. Aquarium gravel (per group)
- 1 c. Sand (per group)

Preparation

- Print a Student Handout for each student.
- Fill one small cup halfway with aquarium gravel and one small cup halfway with sand for each group.
- Place a spoon next to the 2 small cups for each group.
- Precut or roll clay into balls; each group will get 2 balls.
- Place all materials in a central location for students to access as needed.

Connections



SEP Connection

Developing and Using Models

During this activity, students will develop and use models to develop explanations for phenomena, to go beyond the observable and make predictions or to test designs.

While students work through this activity, they should do the following:

- Use models to develop explanations for phenomena
- Use models to make predictions
- Use models to test designs

Once students have completed this activity, ask these questions:

- How did the model help to explain the phenomenon?
- What were some limitations of the model?
- How could the model be improved so that it is a better representation of the phenomenon?

CCC Connection

Systems and System Models

During this activity, students will explore systems and system models.

Ask students the following questions:

- Where do you see systems and system models in this activity?
- Where have you seen systems and system models before this activity?
- Where do you see systems and system models outside the classroom?
- Where do you think you will see systems and system models in other science lessons?



Home



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Explore



Explain



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Evaluate



Intervention



Acceleration



Procedure and Facilitation

1. Explain to students that fossils can be traces of organisms' actions, such as footprints, scat (feces), or tunnels. They can also look like the skeleton of all or part of an organism when minerals replace the original organism during the fossilization process. In this investigation, students will examine imprints as trace fossils using different materials to determine which soil type preserves the greatest detail of a fossil.
2. Distribute a Student Handout to each student.
3. Place students in groups to complete this task.
4. Remind students that materials are to be used only as instructed and that they may not need to use the entire amount given to complete the investigation.
5. Distribute a set of imprint-making objects, the cups of gravel and sand, and the modeling clay to each group.
6. Instruct each group to flatten their clay to make a circular shape that will fit in the bottom of their clear cup.
7. Have groups choose imprint-making objects and press them into the clay to make imprints.
8. Instruct groups to repeat this process with the same objects so that they each have two imprints of the same object.
9. Take a picture of each group's imprints with the digital camera.
10. Have each group sprinkle a small amount of flour on the bottom of their cup to prevent sticking.
11. Instruct each group to place one imprint in the bottom of their plastic cup with the imprint facing up and layer about 2 cm of the fine sand on top, completely covering the fossil.
12. Have each group place their second imprint on top of the sand with the imprint facing up and layer about 2 cm of the gravel on top, completely covering the fossil.
13. Instruct groups to use the bottoms of their other clear cups or their hands to press down firmly on the gravel.
14. Have groups gently turn their cups over with the layers upside down onto paper plates (like when they're building sandcastles) and slowly lift the cups off.
15. Instruct groups to carefully collect and separate their fossils, brushing off the soil.
16. Have each group examine each fossil and compare it to their group's "before" picture to determine which soil type best preserved the detail of their fossils.

ACTIVITY TIP

Model imprinting the object making sure to make imprints as similar as possible. Choose objects based on the size of cups and ease of use. Label imprints for reference later.

CLASSROOM MANAGEMENT TIP

To monitor student progress, place premade cups of soils on a separate table. Students may retrieve gravel cup with teacher's approval after completing the first layer of sand.

STEMSCOPES TIP

Share the Career Connections element with students prior to the activity. Explain to them that scientists study fossils to learn about the past, and must pay very special attention to detail.

Notes

Explore 1: Activity - Nature of Science

Encourage the students to use as much detail as possible while drawing pictures. Have students label parts of their imprints and note particle size of different soils.

17. Lead the class in a discussion.
- Which soil type best preserved the detail of the fossil? **Sand**
 - Why do you think that soil type was the best? **The smaller pieces of the sand did not cause as much damage as the big rock pieces.**
 - What does this tell you about the challenges paleontologists face when searching for fossils? **The rocks could destroy important parts of the fossil and make it more difficult to identify. Rocks could prevent you from seeing the entire organism. Organisms may not be as well preserved in places where there is not much sediment or sand.**

Once students have completed this learning activity, revisit the Student Wondering of Phenomenon and use the following questions to guide a class discussion.

- How does this activity connect to or answer the question above?
- How does this activity change your thinking about the phenomenon?
- Do you have any additional questions or observations about the connection between the phenomenon and the activity?

Notes



Fossils

Explore 2: Engineering Solution - Fossil Dig

Activity Preparation



Timestamp: 1–2 hr.

Students will look at pictures and will determine the types of fossils found and the types of environments those organisms lived in.

Materials

Printed

- 1 Set of Fossil Cards (per group)
- 1 Fossil Key (per group)
- 1 Student Handout: Fossil Dig (per student)
- 1 Fossil Dig Claim-Evidence-Reasoning (per student)
- 1 Student Rubric (per student)

Reusable

- None

Consumable

- None

Preparation

- Print a Student Handout, a Student Rubric, and a Fossil Dig Claim-Evidence-Reasoning for each student.
- Print a set of Fossil Cards for each group. Cut apart the cards, and place each set in a pile for each group.
- Print a Fossil Key for each group.

Connections



SEP Connection

Obtaining, Evaluating, and Communicating Information

During this activity, students will obtain, evaluate, and communicate information from scientific texts in order to derive meaning, evaluate validity, and integrate information.

While students work through this activity, they should do the following:

- Obtain, evaluate, and communicate information from scientific texts to derive meaning
- Obtain, evaluate, and communicate information from scientific texts to evaluate validity
- Obtain, evaluate, and communicate information from scientific texts to integrate information

Once students have completed this activity, ask these questions:

- What is the best way to communicate the information you received in this activity to others?
- How can you validate the information found in this activity?
- How does the information in the activity prove or disprove information found in the STEMscopedia?

Finally, ask students to compare and contrast a phenomenon from the activity to scientific texts, finding evidence to support their explanations of the phenomenon.

CCC Connection

Patterns

During this activity, students will explore observations and explanations of patterns.

Ask students the following questions:

- Where do you see observations and explanations of patterns in this activity?
- Where have you seen observations and explanations of patterns before this activity?
- Where do you see observations and explanations of patterns outside the classroom?
- Where do you think you will see observations and explanations of patterns in other science lessons?



Home



Engage



Explore



Explain



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Intervention



Acceleration



Procedure and Facilitation

1. Distribute a Student Handout and a Student Rubric to each student.
2. Place students in groups to complete this task.
3. Distribute a Fossil Key and a set of fossil cards to each group.
4. Introduce the problem of this Explore to students: You are part of an paleontological team that has excavated fossils that were buried 100 meters under Earth's surface. Your team also collected and recorded the fossils they found at shallower levels as they were digging. Your team is beginning to notice that the fossils from different depths look different from each other. Your team is trying to figure out why the fossils found at 70 meters are completely different from the ones they found at 100 meters.
5. Review the challenge and criteria and constraints of this Explore with students.
 - The challenge: Look at the pictures of the fossils found at each depth. Use the key to determine the organisms from which each fossil formed and the type of environment it lived in. Use this knowledge to create a poster that explains the changes in the environment where the fossils were found.
 - Criteria and constraints:
 - All members of the group must participate in the creation and presentation of the poster.
 - Posters should show how the fossils would be layered underground.
 - Include 2-3 sentences describing the environment and the fossils for each layer.
 - Optional: Include pictures of what the living organisms would have looked like.
6. Guide students in following the procedures and answering the questions on their Student Handouts.
7. Monitor student groups to ensure they remain within their design parameters.
8. Once students have created their designs, they should test their designs and refine them as needed.
9. Have students use their Student Rubrics to ensure the quality of their work.

ACTIVITY TIP

Set a timer for students to organize fossils and plan out their poster. Actively monitor student progress and allow students to proceed to creating poster with teacher's permission.

STEMSCOPES TIP

Allow students to read STEMscopedia before writing their reasoning response of their C-E-R. Direct students to specific sections and have students annotate important information.

Notes

Explore 2: Engineering Solution - Fossil Dig

- ## Phenomenon Connection

What do fossils tell us about the past of an environment?

- How does this activity connect to or answer the question above?
- How does this activity change your thinking about the phenomenon?
- Do you have any additional questions or observations about the connection between the phenomenon and the activity?

Notes



Fossils

Scope Resources and Assessment Planner

Scope Resources



Explain

☐ **Picture Vocabulary**

A slide presentation of important vocabulary terms along with a picture and definition.

☐ **STEMscopedia**

Reference materials that includes parent connections, career connections, technology, and science news.

☐ **Linking Literacy**

Strategies to help students comprehend difficult informational text.



Elaborate

☐ **Math Connections**

A practice that uses grade-level appropriate math activities to address the concept.

☐ **Reading Science - Lone Star Dinosaur**

A reading passage about the concept, which includes five to eight comprehension questions.

☐ **Engineering Connections**

A creative, kinesthetic extension into engineering and design that uses concepts addressed in the scope.



Evaluate

☐ **Claim-Evidence-Reasoning**

An assessment in which students write a scientific explanation to show their understanding of the concept in a way that uses evidence.

☐ **Open-Ended Response Assessment**

A short-answer and essay assessment to evaluate student mastery of the concept.

☐ **Multiple Choice Assessment**

A standards-based assessment designed to gauge students' understanding of the science concept using their selections of the best possible answers from a list of choices



Intervention

☐ **Guided Practice**

A guide that shows the teacher how to administer a small-group lesson to students who need intervention on the topic.



Acceleration

☐ **Extensions**

A set of ideas and activities that can help further elaborate on the concept.

Notes



Home



Engage



Explore



Explain



Elaborate



Evaluate



Intervention



Acceleration



Assessment Planner

Use this template to decide how to assess your students for concept mastery. Depending on the format of the assessment, you can identify prompts and intended responses that would measure student mastery of the expectation. See the beginning of this scope to identify standards and grade-level expectations.

Student Learning Objectives

What Prompts Will Be Used?

What Does Student Mastery Look Like?

obtain, evaluate, and communicate information about what a fossil is and ways a fossil can provide information about the past, such as a) the nature of environments and b) animals that existed long ago but no longer exist.