

How does a footprint become a fossil?

Teaching and Learning Focus

In the last investigation, students learned about body fossils, fossils that are the actual organism or some part of it or the imprint of the organism or some part of it. In this investigation, students examine **trace fossils**, which are physical evidence of the life activities of now vanished organisms. Trace fossils include tracks, trails, burrows, feeding marks, and resting marks. For example, a trace fossil is the trail left behind by an ancient reptile that dragged its tail in mud. Another example is the footprints left by dinosaurs along an ancient river or the hollow tubes created by worms burrowing in soft mud in an ancient ocean. There are more trace fossils than body fossils because one organism can leave behind many traces (e.g. footprints), but only one set of hard parts (e.g. bones) to become a fossil.

Most trace fossils were formed in soft mud or sand near a pond, lake, river, or beach. The imprints left by the organisms were quickly covered by sediment. The sediment dried and hardened before the imprints could be erased by water or wind. The sediment was then buried under more sediment and became compacted and cemented together to form rock. This process is much the same as the formation of body fossils.

In this investigation, students model the formation of a trace fossil. Using Plaster of Paris and small plastic dinosaurs, they make a series of dinosaur foot tracks (forming a mold). After the Plaster of Paris has dried, they paint it to look more realistic. They cover it with non-stick cooking spray and then with a new layer of plaster (forming a cast). After the new layer has dried, groups exchange their plaster pieces. They split the two sections apart and examine the fossil footprints inside. They examine the footprints for information about what the dinosaurs that created them were like.

Materials Needed

Per group:

- Plaster of Paris
- plastic measuring spoons
- stirring sticks
- water
- milk carton (with the top portion cut off)
- two measuring cups
- non-stick cooking spray
- brown paint
- paint brush
- plastic dinosaur models
- safety impact goggles for each student
- blunt knives to split Plaster of Paris

Images to be viewed by the class:

- Images of Footprints
- Images of Trace Fossils

For the instructor:

- flip chart or whiteboard
- markers

Safety

Use disposable craft sticks for mixing the Plaster of Paris. Be sure that you, and not your students, mix the Plaster of Paris. Do not pour unused portions of Plaster of Paris, or water mixed with Plaster of Paris into the sink or drain. Dispose of them in the trash instead. Students should wear safety impact goggles when cracking the Plaster of Paris. Review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

Many of your students will not think of ancient tracks, trails, burrows, feeding marks, and resting marks preserved in rock as fossils. Begin the investigation by introducing students to the notion that animals can leave trace marks in sediment and information can be derived from those marks. Show students the **Images of Footprints**.

- Image of a Footprints Word Document (2.69 MB)
- Image of a Footprints Adobe PDF (370 KB)

Ask them the following:

1. **What do you see in the pictures?**
2. **What may have made the imprints in the sand or mud?**
3. **What can you tell about the size of whatever made the imprints?**
4. **What does the pattern of the imprints tell you about the behavior of whatever may have made them?**

Have your students discuss these questions, first in pairs, then groups and then as a whole class. Record their answers on a flipchart that you can refer to throughout the investigation.

Presenting the Investigation Question

After the scene is set, introduce your students to the investigation question:

1. **How does a footprint become a fossil?**

Have your students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on a flipchart.

Have your students brainstorm ideas about how this investigation question could be investigated.

2. **How would you design an experiment that could be used to test the investigation question?**
3. **What materials would you need?**
4. **What would you have to do?**
5. **What would you measure?**
6. **How long would the experiment take?**

Tell your students that they will be investigating this question and at the end of their study they will be able to provide reliable answers.

Assessing What Your Students Already Know

In the last investigation, students determined that fossils form as sediments turn to rock. They may recognize that the traces left by animals in sediments may remain after the sediment hardens into rock.

Here are some questions that your students can discuss, in pairs, then in groups:

1. **If a footprint is made by an animal in sediment, such as sand, and the sediment turns to rock, what do you think would happen to the footprint?**
2. **What can the footprints left behind by an animal tell you about what the animal was like?**

Have your students share their ideas with the class and record them as a list on a flipchart.

Ask students the following:

3. **What would you like to learn about how a footprint becomes a fossil?**

Record their ideas on the flipchart as a list called “Questions we have about how a footprint becomes a fossil.” This list will provide further insights into what your students know, and also what they would like to know. By the end of the investigation, some of these questions will probably be answered.

Exploring the Concept

1. Explain to students that they will be making fossilized dinosaur footprints using Plaster of Paris and model dinosaurs. Each group will receive one or more dinosaurs. Groups should try not to let other groups see what their dinosaur(s) looks like.
2. Have students pour one cup of pre-mixed Plaster of Paris in the bottom portion of a milk carton. They should add more water, if necessary, to make a soupy mixture.
3. Students then let the plaster set until it is almost hard. The time will vary from a few minutes to 10 minutes.
4. Instruct students to spray the feet of their plastic model dinosaurs with cooking spray. They will be putting the feet in the plaster, and the cooking spray prevents the plaster from sticking to the plastic.
5. When ready, have students press the feet into the plaster, creating footprints. They should make more footprints to give the impression that the dinosaur was walking. If they have more than one dinosaur, they can make multiple track ways.
6. After students have made their track ways, they should let the plaster dry. After it has dried, they can paint the plaster with brown paint to make a more realistic-looking fossil.
7. After the paint has dried, have students spray the tops of the samples with non-stick cooking spray. They then cover the samples with a new layer of Plaster of Paris. Ask students the following:
 - **How do you think the way in which footprints become fossils is similar to the way in which you created footprints with the plaster?**
 - **How might it be different?**
8. After the plaster has dried, students exchange their plaster pieces with those of another group. Wearing goggles, they use the blunt knives to split the sections apart and examine the fossil footprints inside. Have students consider the following questions in their examination:
 - **How many types of dinosaurs made tracks?**
 - **How many legs did each dinosaur have?**
 - **What kind of feet did each dinosaur have? Are they all the same?**
 - **How can you tell the direction each dinosaur was walking?**
 - **If there are more than one set of tracks, in what order were the tracks made?**
 - **What information do you know for sure from the footprints?**
 - **What information is only a guess?**
9. Discuss students' findings as a class. Help students to understand that fossil footprints happen when an animal steps into a moist surface, such as the mud or sand along a shoreline. The sediment containing the footprints eventually dries. Once it is dry, it is more resistant to the effects of wind or water. Eventually, a new layer of sediment buries the hardened mud or sand, preserving the footprints. As the sediment becomes compacted and cemented together to form rock, the footprints become fossilized. Help students to also understand that, much as they did, scientists analyze fossil footprints to find out more information about an animal, like how it walked or the shape of its feet. Introduce the term "trace fossil" to students. You may want to provide other examples of trace fossils, including trails, burrows, feeding marks, and resting marks.

Applying Students' Understanding

Show students the **Images of Trace Fossils**. Ask them to answer the following questions:

- Image of Trace Fossils Word Document (4.58 MB)
 - Image of Trace Fossils Adobe PDF (292 KB)
1. **Describe what you see in the images.**
 2. **How were the impressions formed?**
 3. **What do the impressions tell you about the living things that formed them?**

Revisiting Investigation Question 4

Complete this investigation by asking your students the following:

1. **How have your ideas about how a footprint can become a fossil changed as a result of this investigation?**

As a result of this investigation, students should be able to state that trace fossils are the remnants of the activities of ancient organisms. Trace fossils include footprints, trails, burrows, feeding marks, and resting marks. Trace fossils provide information

about the organism that is not revealed by body fossils. Trace fossils are formed when an organism makes a mark in mud or sand. The sediment dries and hardens. It is covered by a new layer of sediment. As the sediment turns to rock through compaction and cementation, the remnant becomes fossilized.

Digging Deeper

The following passage provides more detailed information related to this investigation that you may choose to explain to your students.

Dinosaurs and Their Tracks

Dinosaurs emerged about 228 million years ago and roamed the Earth for over 160 million years. About 65 million years ago, they vanished from the fossil record. Scientists have come up with many theories as to why the dinosaurs became extinct. A widely accepted theory, based on very strong evidence, suggests that it was due to the impact of an asteroid.

Dinosaurs belong to a group of reptiles known as archosaurs. Modern day archosaurs include crocodiles and birds. An archosaur is defined by an extra hole in the skull, located in front of the eye. Dinosaurs are further defined by a hole in the middle of the pelvis. No other animal on Earth has ever exhibited this feature. The hole in the pelvis allowed dinosaurs to walk with their legs directly beneath them, as opposed to the sprawling stance of other reptiles.

Dinosaur footprint trace fossils have been discovered on all continents except Antarctica. They have been found in layers of sedimentary rock ranging in age from 230 million years ago to 65 million years ago. Paleontologists have learned much about dinosaurs from their footprints, mainly by comparing them with living animals. Mammals are the best modern organisms for comparison because they walk erectly, like the dinosaurs. For example, elephant tracks and Apatosaurus dinosaur tracks are very similar.

Fossil Unit Sections

Introduction

What is a Fossil?

How Fossils Form

Fossils From Living Things

Fossil Footprints

What Can Fossil Footprints Tell Us?
