How does a living thing become a fossil?

Teaching and Learning Focus

Living things can die and decay. Soft parts are more likely to decay than hard parts. For this reason, the most common fossils are bones, teeth, shells, and the woody stems of plants. For a fossil to form, an organism must be buried quickly so that any oxygen is cut off and its decay slows down or stops.

In this investigation, students continue to think about how fossils form and simulate how fossil molds, fossil casts, and petrified fossils form. Fossils are rarely the original unchanged remains of plants or animals. Fossil formation begins when an organism or part of an organism falls into soft sediment, such as mud. The organism or part then gets quickly buried by more sediment. As more and more sediment collects on top, the layer with the organism or part becomes compacted. Minerals from water then move into the pore spaces between sediment particles. The sediment cements together and becomes rock with the organism or part inside.

Sometimes, open pores in the rock let water and air reach the organism or part, causing it to decay or dissolve. What is left behind is a cavity in the rock where the organism or part was. This empty space is called a mold. A mold shows the original shape and surface of the organism or part. Sometimes, sand or mud fills a mold and hardens, forming a cast of the original organism or part. A cast is a replica of the original organism. Petrification happens when mineral solutions remove the original organism or part and replace it with new minerals. The replacement of the original materials is generally a very slow process. The result is a nearly perfect mineral replica of the original organism or part.

Materials Needed

Per group:

- plaster of Paris (mix as needed using three heaping teaspoons to two teaspoons of water)
- shell or bone
- clay
- small container
- 2 sponges
- Epsom salts
- water
- food coloring
- aluminum pan
- safety impact goggles for each student

For the instructor:

- fossil specimens, including fossil molds, fossil casts, or petrified fossils (can be purchased from commercial suppliers, e.g. Educational Fossils)
- Images of Fossils
- flip chart or whiteboard and markers

Safety

Use disposable craft sticks for mixing the plaster of Paris. Be sure to mix the plaster of Paris yourself. Do not pour unused portions of plaster of Pairs, 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 hardened plaster of Paris. Monitor students around the hot water to make sure they do not burn themselves. The hot water should not be boiling. Review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

Show students samples of fossils. Have students think about the following question: *"Is a fossil the actual remains of a living thing or something else? If it is something else, what is it?"* Have students discuss first in pairs, then groups and then as a whole class. Record their answers on a flipchart to refer to throughout the investigation.

Presenting the Investigation Question

Introduce your students to the investigation question: *"How does a living thing 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 students brainstorm ideas about how to investigate this question:

1. What materials would be needed?
2. What would you have to do?
3. What would be measured?
4. How long would the experiment take?

Tell 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

Before completing this investigation, students should know that decay slows down after an organism is covered by sediment. They probably do not know what happens to

the organism after it is covered and the sediment turns to rock. They may think that the organism remains as it is.

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

1. What happens to a living thing after it is completely buried by mud or sand?
2. Can the decay of a living thing be completely stopped?
3. How might water that flows through a rock affect a living thing buried in the rock?
4. What happens to living things buried in sediment as the sediment becomes rock?
5. How do fossils become rock?

Have students share their ideas with the class and record them as a list on a flipchart. Then ask: *"What would you like to learn about how a living thing becomes a fossil?"* Record their ideas on the flipchart as a list called "Questions we have about how a living thing becomes a fossil." This list will provide further insights into what your students know as well as what they would like to know. By the end of the investigation, some of these questions will probably be answered.

Exploring the Concept

Activity 1: Fossil Molds and Fossil Casts
Expected Time: Two half- hour sessions on separate days

1. Explain to students that they will be modeling several processes by which fossils are formed. First, they will model what happens when a shell in the bottom of the ocean or a bone that ended up on the bottom of the ocean becomes fossilized.
2. Ask students to place some clay on the bottom of a small container. Tell them that this clay represents the clay at the bottom of the ocean.
3. Have students press a shell or bone into the clay. Tell them that this is a living thing that was buried in the clay.
4. They should then remove the shell or bone, making a mold. Tell them that over time the mud was compacted and cemented into sedimentary rock. As the rock formed, water entered the rock and dissolved or decayed the shell or bone inside the rock. This left an imprint, or mold. Introduce the term "mold" to students.
5. In a second container, prepare some plaster of Paris by adding water and mixing until it is creamy and barely flowing.
6. Instruct students to pour the plaster of Paris into the mold. Tell them that the space left behind by the shell was later filled with minerals from water that flowed through the spaces in the rock.
7. Students should let the plaster of Paris harden overnight.

8. The next day, students put on goggles to gently tap and remove the fossil cast. Introduce the term "cast" to students as students are removing the fossil from the cast.
9. Ask students the following questions:
    - Are molds and casts the original unchanged remains of a living thing?
    - What features of a living thing are preserved by a mold or cast? (its shape and surface)
10. Have students examine the fossil specimens from the first investigation. Instruct them to identify the fossils as molds, casts, or other.

Activity 2: Petrified Fossils

Expected Time: One half- hour session for initial set up; several days for observations of the sponge; one half- hour session for conclusion and discussion.

1. Explain to students that they will now model a process whereby the remains of a buried organism or part of an organism are replaced by minerals.
2. Have students cut two pieces of sponge into bone shapes. One piece will be used to simulate fossil formation and the other will be used for comparison.
3. Have students fill a cup with hot water and stir in Epsom salts until no more will dissolve. Instruct students to add a few drops of food coloring.
4. Instruct students to pour the salt water mixture into a pan.
5. Have students put one sponge bone into the pan. Instruct them to observe the movement of water through the holes of the sponge.
6. Let the pan sit for several days until the sponge is dry.
7. Have students examine the dry sponge. Ask them the following:
    - How does the sponge compare to the sponge that did not sit in water?
    - Look carefully in the holes of the sponge. Describe what you observe.
    - If the sponge were to decompose or dissolve, what would remain behind? How would this compare to the actual sponge?
    - How does this process compare to the real formation of fossils?
8. Discuss students' findings as a class. They should have observed that the Epsom salts formed crystals in the holes in the sponge. Explain that most hard parts of living things have tiny spaces or holes within them. These spaces can be filled with cells, blood vessels, nerves, or air. When the living thing dies and the soft materials inside the hard parts decay, the tiny spaces become empty. If the hard part is buried, water can seep into the spaces and deposit minerals. The minerals cling to the sides of the holes and replace the original material as it decays.

Applying Students' Understanding

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

1. Identify which images are fossil molds, fossil casts, and petrified fossils.
2. What evidence are you using to make your identifications?

Revisiting the Investigation Question

Complete this investigation by asking your students the following: *"How have your ideas about how living things become fossils changed as a result of this investigation?"*

As a result of this investigation, students should be able to state that after an organism, or part of one, is buried in mud its hard body parts become a fossil as the sediments around it become a rock. If the organism or part dissolves or decays out of the rock, a mold, results. Minerals may then seep into the mold and fill it, forming a cast.

Digging Deeper

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

Body Fossils

Fossils that are the actual organism or some part of it, or the imprint of the organism or some part of it are known as body fossils. In relatively young sediments and rocks, the actual body parts of organisms are often preserved. In older rocks, however, the body parts are usually dissolved away, or re-crystallized, or replaced by another kind of mineral. Even so, the imprints of the organisms are still preserved, and they can be studied if the rock splits apart in the right place to reveal the imprint. Paleontologists usually collect large numbers of rock pieces and then open them in the laboratory with special splitting devices to try to find at least a few fossils.

Hard materials, like bones and shells, have a far higher probability of preservation than soft tissues. For a bone or shell to be preserved, it must only survive being broken or worn away before it is buried. It must also survive being dissolved by chemicals before and after it is buried. Even if the object is dissolved after it is buried, it is likely to be represented by a cavity. This helps the paleontologist almost as well as the entire preserved object. Except in the youngest sedimentary rocks, imprints of the shells of marine invertebrates are just as common as the shells themselves, and usually even more so.

Images of Fossils

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