What is a fossil?

Teaching and Learning Focus

Fossils give us an amazing picture of past life on Earth, but the picture is hardly complete. Only a tiny proportion of organisms that have ever lived are preserved as fossils. The ones that have been preserved tend to be mostly small, shelled invertebrates (organisms without backbones) that lived on the beds of shallow oceans. This is because hard skeletal materials, like bones and shells, have a far higher probability of preservation than soft tissues, which tend to decompose quickly. Fossils of soft-bodied organisms, such as mammals, are very rare. Because fossils are limited to hard parts, we have little idea, or have to guess, about other features of an organism, such as what color it was, whether or not it had fur, or even what the size of its nose was.

The goal of this investigation is for students to develop a basic understanding of what fossils are and how they provide clues about past organisms. Students describe a collection of fossils and consider what was fossilized and what seems to be missing. They see that some parts of organisms are more likely to become fossils than others. Students see that nearly all fossils are from small, shelled ocean creatures. They examine the features of each fossil and come up with ideas about the role those features may have played in keeping the organism alive.

Materials Needed

Per group:

- A variety of fossil specimens (Fossils kits can be purchased from commercial suppliers, e.g. Educational Fossils)
- white index cards, one per fossil specimen
- magnifying lens
- pencil
- (optional) colored pencils, crayons or marker

For the instructor:

- flip chart paper or whiteboard and markers
- Image of a Fossil
- Images of Prehistoric Life

Safety

This investigation is generally considered safe to do with students. However, review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

Many students will have seen fossils in museums, classrooms, or on television or in movies. They will likely know that dinosaurs once roamed the Earth but are now extinct. Begin the investigation by showing students the *Images of Prehistoric Life*. Tell them that these images are of the Earth hundreds of millions of years ago, long before humans existed. They were drawn by artists who were given descriptions by scientists. Discuss:

1. What was life on Earth like hundreds of millions of years ago, both on land and in the oceans?
2. Do you see any living things that look like what we see today?
3. These images were drawn by artists based on scientific evidence. What kind of evidence do you think was used to help the artists create these images?
4. How accurate (or real) are the images?

Have 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. If students have not already suggested that the images are based on fossil evidence, explain this to them. Explain to them as well that they will be conducting a study of fossils, beginning with an examination of some real fossils.

Presenting the Investigation Question

Introduce your students to the investigation question: *"What is a fossil?"* Have students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on a flipchart. 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

Students may have had some personal experiences with fossils, having seen them in museums or on television or the movies. When students hear the word "fossil," they probably think of shells or dinosaur bones. These are known as body fossils and they are good examples of fossils, but there are many other kinds of fossils, including fossilized plants and trace fossils, which are physical evidence of the life activities of now-vanished organisms, such as tracks, trails, burrows, feeding marks, and resting marks.

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

1. What kinds of living things become fossils?
2. How do fossils vary in size?
3. Where are they found?
4. What information can you gain from a fossil?

Have your students share their ideas with the class and record them as a list on the flipchart. Then discuss: *"What would you like to learn about fossils?"*

Record their ideas on the flipchart as a list called "Questions we have about fossils." 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. Distribute fossil specimens and index cards to student groups.
2. Explain to students that they are to observe their fossil specimens in detail, noting all their characteristics. Tell your students that they may use four of their senses to investigate their fossils. (looking, feeling, and smelling). Encourage them to observe specimens from all angles using magnifying lenses.
3. Ask students to complete the following:
    - Sketch the fossil specimens on index cards.
    - Identify any special features or parts on the fossil. How do you think the feature or part may have helped the fossilized living thing to survive? Write your ideas on the card next to the sketch.
4. If the fossil is only part of an animal or plant, ask students to sketch as much of the rest of the specimen as they think it may have appeared.
5. When done, have groups switch fossil specimens and cards. Students observe the fossils and add information to the cards that other groups may not have included.
6. After all the fossils have rotated through the groups, discuss the following:
    - What do all fossils have in common?
    - How are they different?
    - What kinds of things become fossilized?
    - What kinds of living things seem to be missing from this collection?
    - Do you think all living things can become fossils? Why or why not?
    - What are some questions of your own about the fossils?
7. Discuss students' findings as a class. Record answers on the flip chart or board.
8. Help students to understand that a fossil is the remains or evidence of an ancient organism that has been hardened and preserved. The remains can be the entire organism or part of an organism. They can also be a trace from an organism, such as a footprint. Fossils range in size from huge dinosaur skeletons to tiny living things which can only be seen under a microscope. Fossils are also quite old, existing long before humans lived on the Earth.

Applying Students' Understanding

Have students examine the *Image of a Fossil.* Ask them to answer the following questions:

1. Is this a plant or an animal fossil?
2. What parts of the living thing does the fossil show?
3. What do you think this plant or animal looked like when it was alive?

Revisiting the Investigation Question

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

Students should note that fossils are evidence of past life that is preserved in rock. They should also recognize that fossils do not show an entire organism, but only parts.

Digging Deeper

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

Fossiliferous Rocks

A rock that contains fossils is said to be fossiliferous ("fossil-bearing"). Almost all fossils are in sedimentary rocks. They are pretty much nonexistent in igneous rocks, and very uncommon in metamorphic rocks. Some very well-defined fossils can survive a certain degree of metamorphism (change in a rock through heat and pressure). Finding a fossil in a metamorphic rock is an exciting event for a geologist because metamorphism "resets" a rock's age to the date of the metamorphic event. Fossils can help scientists figure out the actual age of the rock, since they were there when it originally formed from sediments. Not all sedimentary rocks, however, have fossils. If they parachuted you out of an airplane to land on an outcrop of sedimentary rock, the chance of your finding a fossil would be rather small – nowhere close to one hundred percent.

Some kinds of sedimentary rocks tend to have more fossils than other kinds of sedimentary rocks. Limestones generally contain the most. That is not surprising, because most limestones consist in part, or even entirely, of the parts of shelly marine organisms. Most coarse-grained limestones, and many fine-grained limestones as well, consist mostly of whole shells or pieces of shells.

Many shales, very fine-grained layered sedimentary rocks originating from freshly deposited mud, contain large numbers of fossils, because certain organisms like to live on muddy sea floors. Shales are often rich in trace fossils, but less so in body fossils except when the chemical conditions during deposition were better for preservation rather than decomposition. The best representatives of soft-bodied organisms are from shales, although examples of such preservation are very uncommon. Many sandstones are fossiliferous as well, although the body fossils in sandstones are usually relatively tough shelly materials, which are not highly susceptible to chemical decomposition. Conglomerates are the least fossiliferous of sedimentary rocks.

Images of Prehistoric Life

Courtesy Wikipedia Commons by Mojcaj
URL: http://en.wikipedia.org/wiki/Image:Mysosaurus.jpg

Courtesy USGS
http://nc.water.usgs.gov/ccp/2004Hope/photos/Image91_web.jpg

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http://pubs.usgs.gov/gip/dynamic/graphics/FigS4-2.gif

Image of a Fossil

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