Fossil Record

Reflect

Seashells seem to be everywhere. Most of the time, you will find them on beaches, but every now and then, you may find them far from the sea. For example, you may find a shell stuck in a rock, high on a mountain. What could this find tell you?

How can fossils tell us about organisms that lived millions of years ago?

Fossils are preserved parts or traces of animals or plants that lived in the past. Fossils are clues to the past. They tell us what organisms lived in a certain place, how they looked, and what the environment was like in the place where they lived. Fossils can also show how organisms have changed over time. If you find fossils of seashells high in a mountain, you could conclude that the mountain used to be underwater at some point in time.

Fossils do not have dates printed on them. Yet, by using particles found around or in the fossils, scientists can tell two things about the organisms that became the fossils: the order in which the organisms lived on Earth and when the organisms lived on Earth.

Figuring out the order is relatively simple. Look at the photo on the right. It shows layers of rock. The layers of rock were formed one on top of the other. The bottom layer was laid down first, so it is the oldest layer. The top layer was laid down last, so it is the youngest layer. The layers in between are older to younger from bottom to top.

Imagine you baked a layer of cake for each day on Monday, Tuesday, Wednesday, and Thursday, and then set each layer on top of the other on the day it was baked. The Monday layer would be at the bottom. The Tuesday layer would sit on top of the Monday layer. The Wednesday layer would come next. Finally, you would put the Thursday layer on the very top. Monday's layer would be the oldest, and Thursday's layer would be the youngest.

Now, let's take this a step further. Let's say you put walnuts in Monday's layer, raisins in Tuesday's layer, cranberries in Wednesday's layer, and chocolate chips in Thursday's layer. You give the cake to a friend who knows that the bottom layer is oldest and the top layer is youngest. What could your friend conclude about the order of the ingredients?

Reflect

Your friend could conclude that the walnuts were added first because they are in the oldest layer, the raisins were added second because they are in the second-oldest layer, the cranberries were added third because they are in the third-oldest layer, and the chocolate chips were added last because they are in the youngest layer.

What does this have to do with the age of fossils? Think of the walnuts, raisins, cranberries, and chocolate chips as fossils. The rock layers in which fossils are found indicate the *order* of the ages of fossils. Fossils in the bottom layer are older than fossils in higher layers. Scientists also have ways to find out the actual age of fossils.

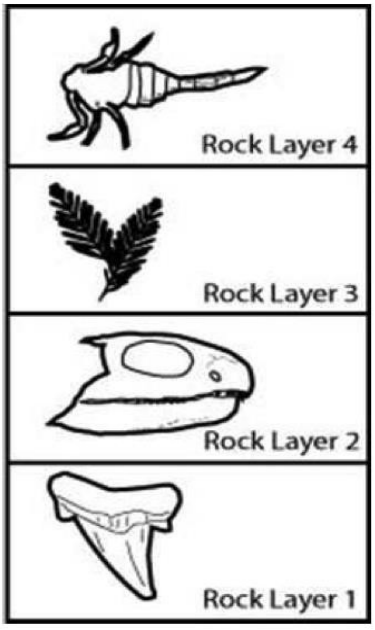
One way to determine the actual age of a fossil is to determine the age of the rock layer in which the fossil is found. This makes sense because the organism that produced the fossil was trapped in the rock when it formed. How long ago did the last dinosaurs become **extinct**, or die out forever? The youngest dinosaur fossils are found in rock layers that are about 65 million years old. Therefore, we can use that evidence to conclude that dinosaurs became extinct about 65 million years ago.

Evidence from fossils shows that dinosaurs became extinct about 65 million years ago.

You may be wondering how scientists figure out the actual age of rock layers and fossils. The process is a bit complex. If you are curious, do an Internet search using the key words *radioactive dating.*

What Do You Think?

Take a look at the illustrations on the right. They show fossils found in different layers of rock. What is the order of these fossils from oldest to youngest?



Remember, fossils are rarely the actual organisms themselves. Rather, their body parts have broken down and been replaced with mineral solutions that have hardened into rock.

What do you call scientists who study fossils?
They are called paleontologists. Paleontology is the scientific study of prehistoric life. Paleontologists use fossils to figure out three main things about fossils: the identity and origin of the fossil, the fossil's environment, and what the fossil can tell us about the history of Earth.

Reflect

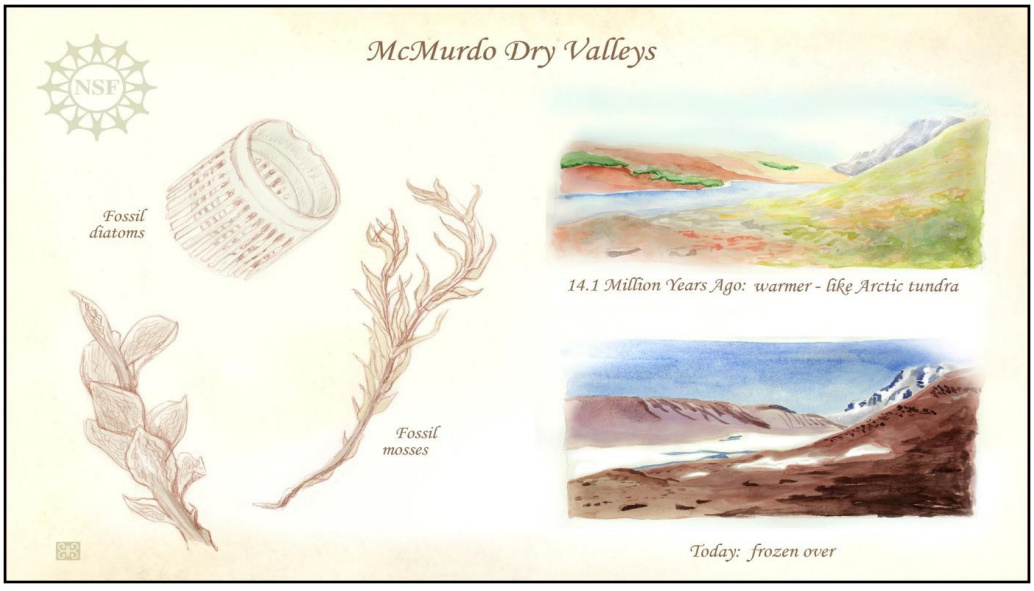
How can fossils tell us what environments were like millions of years ago?
Scientists tell us that environments change over time. However, what evidence backs up this claim? In 1988, Gordon Hubbell and a team of fossil hunters dug a hole in a desert in Peru. This desert is one of the driest places on Earth; almost no rain falls there. After digging for a while, Hubbell discovered a jawbone and more than 200 sharp, triangular teeth. Hubbell is an expert in fossil sharks. He recognized that the teeth belonged to an ancestor of the great white shark.

For about 20 years, the teeth were stored in Hubbell's collection of fossils. Then, in the early 2000s, a team from the Museum of Natural History in Gainesville, Florida, figured out that the age of the fossil teeth was four million years old! The conclusion? Four million years ago, one of today's driest places was under water. Fossils provided evidence that the environment in this place had greatly changed.

A great white shark bares its teeth.

Here is another example. Today, the continent of Antarctica, which surrounds Earth's South Pole, is the coldest place on our planet. Temperatures there can dive below -84°C (-120°F). No plants or animals permanently make their homes in the interior of Antarctica. Has Antarctica always been this cold and empty of living things? According to fossil evidence, the answer is no.

Scientists exploring the Dry Valleys area in Antarctica found fossils of mosses and tiny animals. The fossils were unearthed in ancient lake beds. The scientists calculated that the fossils were about 14.1 million years old. At that time, shrubs grew from the ground around the lakes. Some insects lived there, too. To support these living things, summer temperatures would had to have been much warmer than they are now. Again, fossils provided evidence that an environment on Earth had changed greatly over time.



Look Out!

Not all parts of an ancient organism can form a fossil. Fossils are most often formed from the hard parts of organisms. The soft parts usually break down before they can be preserved in rock. However, there are exceptions.

For example, animals trapped under ice may be preserved whole. This is what happened to some wooly mammoths, like the one shown in the image on the top right. Wooly mammoths are extinct animals that looked a bit like modern elephants. Some lived in the icy regions close to the North Pole. Some insects have been preserved whole, too. This is especially true of insects trapped in tree sap. When the sap hardens, the insect is preserved inside. This happened to the mosquito in the image on the bottom right.

How can we represent fossils and past environments using models?
Scientists often use models to describe objects or events in nature. A model is a representation of a real thing. A model may be as simple as a drawing or a shape made out of clay. It may be an animal reconstructed from just a few fossil bones. The fossils in the dinosaur skeleton shown below were used to make a model of a complete dinosaur.

Another type of model is a diorama that shows both an organism and its environment. The environment may be in the present or in the distant past. The American Museum of Natural History in New York City shows two organisms related to human beings, walking on a dusty plain in Africa. This model was based on actual fossil footprints preserved in rock. By studying the shapes of the footprints, scientists can draw conclusions about the body shapes and sizes of the organisms that made the prints.

Try Now

Collect a variety of small objects, such as stones, leaves, coins, or marbles. Make an imprint of each object by pressing one side of the object into a piece of modeling clay. These imprints represent fossils. Label each imprint with a number, and create a key to identify each imprint. Ask your classmates to try to identify the source of each “fossil” (the object that made each imprint) and explain how they came up with their answers.

Try Now

What Do You Know?

The following chart lists five different locations on Earth today. Suppose that scientists find a fossil of an ancient organism in each location. Based on the type of fossil found there, decide how the location has changed over time. In particular, determine whether each location.

- Used to be a forest
- Used to be underwater
- Used to be a tropical island
- Has not changed since the fossil was formed

Fossil	Where was it found?	How has the location changed?
Sea shell	The side of a mountain	
Palm branch	An ice sheet in the Arctic	
Imprint of a cactus leaf	A desert	
Insect trapped in the tree sap	Under the ocean floor	
Shark tooth	A wide-open grassland	





Discover Science: What "Lucy" Tells Us

In 1974, fossil hunters working in Africa discovered a nearly complete skeleton of an organism related to human beings. Scientists determined that the skeleton belonged to an adult female. They also calculated that she lived a little more than three million years ago. They named the skeleton "Lucy." Studies of Lucy's bones revealed a number of things about her: She was less than 1.1 meters (3½ feet) tall, and she probably weighed less than 30 kilograms (66 pounds). Most importantly, her bone structure provided evidence that she walked upright. Fossilized footprints, also found in Africa, further support this conclusion. The footprints belonged to other members of Lucy's group of organisms. The footprints clearly showed two organisms walking much as we do today. As far as scientists know, Lucy and her kind were the first human-like organisms to walk upright.

Reflect

The Fossil Record

Fossil record is the collective accumulation of the remains of organisms from all over the world that have been preserved, particularly in rock, and which are generally at least 10,000 years old. When viewed as a whole, fossil record can provide interesting information about the evolution of life on Earth. Scientists consider the remains they have found to be extremely precious and apply what they learn from these remains in multiple disciplines. They try to fill in gaps in the record to have a better understanding of the world.

What Scientists Look At

Obviously, people look at the fossil record, in whole or in part, to learn about the organisms that have been preserved. They often try to piece together how living things interacted from this basic information. Two related areas that also get attention, however, are the exact placement of the fossils in Earth and how they were created. These elements provide clues about things such as migration, habitat, date of life, and geological and meteorological conditions, structures, or events. These types of studies are important to many different scientific areas.

Diversity in Fossils

Despite the fact that a small number of living things are preserved as fossils, the diversity of those creatures is significant. What has been found is only a small percentage of what is available for discovery. Paleontologists and related scientists have located remains ranging from microscopic bacteria to massive mammals—dinosaurs being perhaps the most well-known fossils. Comparing this evidence to modern-day ecosystems, people know that ancient Earth was not the same as it is today, but the question of why certain life forms became extinct is still one of the mysteries of science.

Extinction

Extinction is an evolutionary process that leads to the disappearance of a species or a population. When a species becomes extinct, its entire gene pool is lost. Through evolution, a species can give rise to another species as some of its members adapt to environmental changes or undergo changes in their gene pool. This process is known as speciation, or the birth of a new species. Speciation and extinction are both part of the natural evolutionary process of living beings. The most famous extinction event happened 65.5 million years ago and wiped out 50% of all species living at the time, including all the families of dinosaurs.

Connecting With Your Child

Let's Make a Fossil!
Fossils are remains of life from the past. The most common kinds of fossil preservations are molds and casts. This activity will give your child the chance to make their own modern-day molds and casts.

Materials
Modeling clay
Plaster of Paris ™
12–16 oz plastic soda bottles
Small paper cups (6-oz size)
Leaves, plastic dinosaurs or bugs, shells, and twigs
Water bucket or bowl for mixing plaster
Paper towels
Toothpicks
Labels

Procedure:
1. Cut plastic bottles into 2-inch rings.
2. Cut off the tops of the paper cups, leaving approximately 1 inch to the bottom.
3. Divide clay into portions for the bottle rings.
4. Press clay into the ring bottoms, leaving ½ inch of room at the tops of the rings. Make sure the clay is smooth. Any marks in the clay will appear after the fossil has been made.
5. Choose which objects to press into the clay and the Plaster of Paris™.
6. Press objects into clay and then remove them. Try to keep the image as clean as possible. If it does not look good, smooth the clay and re-press the image.
7. Mix Plaster of Paris™. Make only the amount you will be able to pour in 2 minutes. Clean the bowl before mixing more. If the bowl is not clean, the next batch will set up too quickly.
8. Pour plaster into the rings, over the impressed images in clay. Continue until all the plastic rings are full.
9. Now, pour the plaster into the paper cups.
10. Let the plaster in the cups set up for 2–3 minutes. The plaster needs to stiffen until it can keep the shape of the object. When it reaches this point, have your child carefully press the object into the plaster and let it sit for a minute or two.
11. Carefully remove the object.
12. Let all molds and casts sit for at least 30 minutes.
13. Once hardened, remove the paper cup from around the plaster to reveal the cast. Push the plaster and clay through the ring and remove the clay from plaster to reveal the mold.

Connecting With Your Child

Here are some questions to discuss with your child:

1. Let your child write on the bottom of each fossil the name of the object used and if it was made from a cast (Plaster of Paris™) or a mold (clay).
2. Have your child form two lists and describe what they observe about the two types of "fossils": hair, shape, texture, size, color, etc.
3. Have your child write on paper which fossil indicates the most information (the mold or the 3-D cast) and why.
4. What is a fossil?
5. What parts of ancient organisms are most likely to become fossils?
6. In what materials are most fossils found?
7. If you found two different fossils, what is one way you might be able to tell which is older?
8. What can a fossil tell you about ancient organisms?