

**California Science Standards****7.3.c, 7.4.c, 7.4.e****BEFORE YOU READ**

After you read this section, you should be able to answer these questions:

- What are fossils?
- How are fossils formed?
- What can fossils tell us about the history of life on earth?

What Are Fossils?

Organize Make a spider map to show the different ways fossils can form.

Can you name any dinosaurs? Do you know what they looked like or how they moved? Scientists have been able to tell us many things about organisms, such as dinosaurs, that lived millions of years ago. How do scientists learn about these organisms if they have never seen them? They study fossils. A **fossil** is the trace or remains of an organism that lived long ago. Fossils can form in five different ways.

**READING CHECK**

1. Define What is a fossil?

FOSSILS IN ROCKS

Usually when an organism dies, it begins to decay or it is eaten by other organisms. Sometimes, organisms are quickly buried by sediment when they die. Sediment can preserve the organism. Hard parts, such as shells, teeth, and bones, are preserved more often than soft parts, such as organs and skin. The parts of the organism that remain can become fossils when sediment hardens to form sedimentary rock.

**READING CHECK**

2. List Give three examples of hard parts of an organism that could become fossils.

FOSSILS IN AMBER

Sometimes organisms such as insects are caught in sticky tree sap. If the sap hardens around the insect, a fossil is created. Hardened tree sap is called *amber*. Some of the best insect fossils are found in amber. Frogs and lizards have also been found in amber.



This insect is preserved in amber. It is more than 38 million years old.

SECTION 1 Looking at Fossils *continued***FROZEN FOSSILS**

Ice and cold temperatures slow down decay and can allow fossils to form. Woolly mammoths, which are relatives of modern elephants, became extinct about 10,000 years ago. Scientists have found frozen remains of mammoths preserved in blocks of ice. By studying these fossils, scientists hope to learn more about the mammoths and their environment.



Discuss Have you ever seen any fossils? What kind of organisms were they? Where did you see them? How were they made? Describe these fossils to your classmates.

PETRIFICATION

Organisms can also become fossils by petrification. In *petrification*, minerals replace an organism's tissues. During one form of petrification, minerals fill the tiny spaces in an organism's hard tissues, such as bone. Sometimes, the organism's tissues are completely replaced by minerals. In petrified wood, for example, all of a tree's wood is replaced by minerals. The wood becomes a rock.



3. Define What is petrification?

FOSSILS IN ASPHALT

In some places asphalt can bubble at the Earth's surface and form sticky pools. The La Brea asphalt deposits in Los Angeles, California, are at least 38,000 years old. These pools have trapped and preserved many different organisms. These include saber-toothed cats and dire wolves that lived from 10,000 to 40,000 years ago. From these fossils, scientists have learned about the ancient environment of southern California.

What Other Kinds of Fossils Have Been Found?

Organisms can leave behind clues about their lives. These clues are also fossils. These fossils were made by an organism, but they do not include parts of the organism's body.



4. Define What is a trace fossil?

TRACE FOSSILS

Evidence of an organism and its activities can be fossilized. This is called a **trace fossil**. Tracks are an example of a trace fossil. They form when footprints are filled with sediment and preserved in rock. Tracks can show how big an animal was and how fast it was moving. For example, parallel paths of dinosaur tracks have led scientists to hypothesize that some dinosaurs moved in herds.

SECTION 1 Looking at Fossils *continued***TAKE A LOOK**

5. Identify What kind of fossils are dinosaur tracks?



These dinosaur tracks are found in Arizona. They show that the dinosaur was running when it made the tracks.

Burrows are another kind of trace fossil. *Burrows* are shelters made by animals such as clams that bury themselves in sediment. A burrow is preserved when it is filled with sediment and buried quickly. A coprolite is also a trace fossil. *Coprolites* are preserved animal dung.

MOLDS AND CASTS

Molds and casts are two more kinds of fossils. The print, or impression, left in sediment or in rock where a plant or animal was buried is a *mold*. The figure below shows two types of molds from the same organism. One is an internal mold of the inside of the shell. The other is an external mold of the outside of the shell.

A cast is an object that forms when sediment fills a mold and becomes rock. Like a mold, a cast can show what the inside or outside of an organism looked like.

**READING CHECK**

6. Compare What is the difference between a cast and a mold?



The fossil on the left is the internal mold of an ammonite. It formed when the sediment filled the ammonite's shell. On the right is the external mold of the ammonite. The shell later dissolved.

SECTION 1 Looking at Fossils *continued***What Can Fossils Tell Us?**

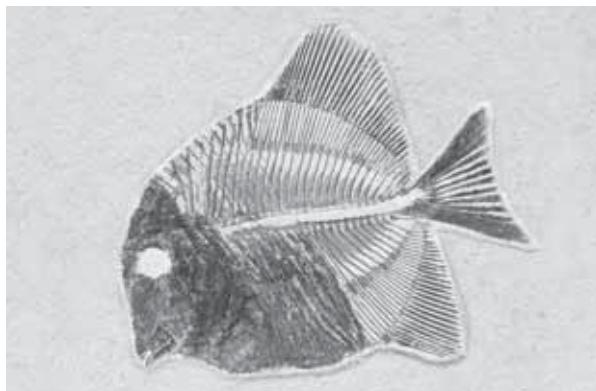
Think about your favorite outdoor place. Observe the plants and animals around you, including the birds, insects, and grasses. Now, imagine that you are a scientist at the same site 65 million years from now. What types of fossils would you dig up? Would you find fossils for every bird, insect, and grass that existed? Based on the fossils you found, how would you reconstruct this place? Fossils can show scientists three main things:

1. the kind of organisms that lived in the past
2. how the environment has changed
3. how organisms have changed

THE INFORMATION IN THE FOSSIL RECORD

Scientists know some of the history of life on Earth from fossils. Some parts of this history are more complete than others. Scientists know more about organisms that had hard body parts than about organisms that had only soft body parts.

Some organisms lived in environments where fossils can form more easily. Scientists also know more about these organisms than those that lived in other environments. The fossil record is incomplete because most organisms never became fossils, and many fossils have not been discovered yet.

**A HISTORY OF ENVIRONMENTAL CHANGES**

Fossils can show evidence of climate change. For example, today Antarctica is covered with ice and snow. However, scientists have found fossil evidence of forests and freshwater organisms in Antarctica. These fossils show that the climate must have been much warmer in the past.

**CALIFORNIA
STANDARDS CHECK**

7.4.e Students know fossils provide evidence of how life and environmental conditions have changed.

Word Help: evidence information showing whether an idea or belief is true or valid

7. List Name three things fossils can show scientists.

TAKE A LOOK

8. Explain What is one reason this organism could be fossilized?

SECTION 1 Looking at Fossils *continued***A HISTORY OF CHANGING ORGANISMS**

To understand how life on Earth has changed, scientists compare fossils. Scientists also look for similarities between fossils and living organisms. However, only a small fraction of the organisms that have existed in Earth's history have been fossilized. As a result, the fossil record is incomplete. This means scientists do not have a continuous record of changes in life on Earth. 

 **READING CHECK**

- 9. Explain** How can scientists find out how life has changed?

How Do Scientists Know How Old Fossils Are?

To understand the history of life on Earth, scientists have put fossils in order based on their ages. How do scientists know how old a fossil is? In some cases, scientists can use *absolute dating methods*, such as radiometric dating, to determine the age of fossils. More commonly, scientists use relative dating methods.

With *relative dating methods*, scientists don't know the exact age of a fossil. However, they do know which fossils are older than others. One of these relative dating methods is called *superposition*. Fossils found in older layers of rock come from more ancient life forms. Fossils found in younger layers of rock are from more recent organisms.

Critical Thinking

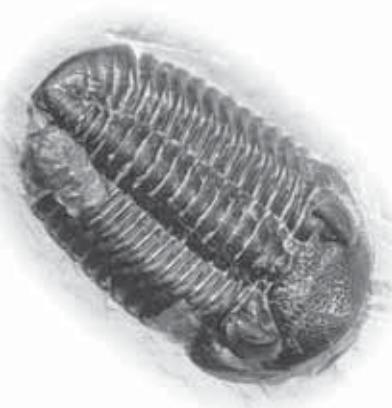
- 10. Explain** Would you expect to find fossils of an organism that lived relatively recently in old layers of rock or in younger layers? Explain your answer.

USING FOSSILS TO DATE ROCKS

Fossils of certain types of organisms can be found all over the world. These fossils are found only in rock layers of a certain age. They are called index fossils.

Index fossils are fossils of organisms that lived during a relatively short geologic time span. To be an index fossil, a fossil organism must be found throughout the world. It must be easy to identify and many fossils of that organism must exist.

Phacops is an example of an index fossil. This organism lived about 400 million years ago. When scientists find *Phacops* in a rock layer, they know the rock layer is about 400 million years old.



Section 1 Review

7.3.c, 7.4.c, 7.4.e

SECTION VOCABULARY

fossil the trace or remains of an organism that lived long ago, most commonly preserved in sedimentary rock

index fossil a fossil that is used to establish the age of a rock layer because the fossil is distinct, abundant, and widespread and the species that formed that fossil existed for only a short span of geologic time

trace fossil a fossilized mark that formed in sedimentary rock by the movement of an animal on or within soft sediment

1. List Give three examples of trace fossils.

2. Explain Why is the fossil record incomplete?

3. Explain Why can some fossils form in cold temperatures?

4. Infer Which kind of organism is more likely to be found as a fossil in amber—a frog or a rabbit? Explain your answer.

5. Apply Concepts What could you conclude if you found a fossil of a tropical plant in a cold climate?

6. List What three conditions must a fossil meet in order to be an index fossil?
