

Science Benchmark: 04: 04

Fossils are evidence of living organisms from the past and are usually preserved in sedimentary rocks. A fossil may be an impression left in sediments, the preserved remains of an organism, or a trace mark showing that an organism once existed. Fossils are usually made from the hard parts of an organism because soft parts decay quickly. Fossils provide clues to Earth's history. They provide evidence that can be used to make inferences about past environment. Fossils can be compared to one another, to living organisms, and to organisms that lived long ago.

Standard IV: Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.

*STUDENT BACKGROUND INFORMATION:***Tales of the Past**

Do you like mystery and intrigue? Do you like to do detective work and and make *inferences*? If you do then you will love to learn about *fossils*. Fossils provide clues to Earth's history. They provide important evidence that helps determine what happened and when it happened in *prehistoric* times. Fossils can be compared to one another, and to *organisms* of today. This information can be used to make inferences about past *environments*. If you were a detective who wanted to discover the history of Earth using fossils, where would you begin to look for clues? To begin, you would want to know fossils were formed.

Some fossils are formed by *impressions*. They show detailed outlines of organisms. Impressions are created when thin plants and small animals die in sediment and rot leaving behind a dark print of the organism. Plants, leaves, feathers and fish are common examples of this type of fossil.

**Imprint**

Molds and casts are impression fossils made by larger organisms. When an organism dies and is covered by sediment, the organism slowly decomposes. A hole (mold) is left in its place. If the hole is later filled with sediment, it produces a cast. The cast will physically look like the original organism on the outside.

Another type of impression fossils show traces of activities of ancient life. These include footprints, teeth marks, tracks, trails, burrows, body outlines, and tail prints. For a

environment : *the surroundings and conditions in which an organism lives*

fossil : *the remains or evidence of ancient organisms*

impression : *a mark or design made on a surface by pressure*

infer : *a process of reasoning from something known or assumed*

organisms : *living things that carry out basic life functions on their own*

prehistoric : *belonging to a period of time before recorded history*

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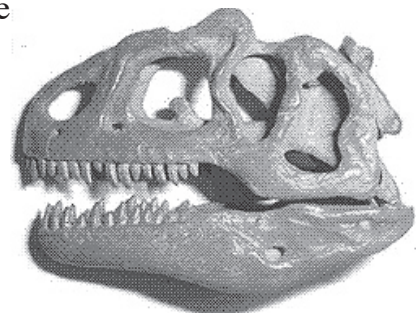
Dinosaur Footprints

trace to become a fossil, an impression needs to be left in soft sediment. The sediment hardens and is *preserved* after being quickly covered with more sediment. This process would be similar to you stepping into some soft soil and leaving your footprints. Your footprints dry up and are then rapidly buried by mud. Over time the mud becomes rock and your footprints become fossils. Eventually the sedimentary rock covering your footprints erodes and your footprints are found. They look just as they did when you stepped in the mud. Those who find your footprints can infer what you looked like and how you walked.

Another type of fossil is a mineral *replacement* (petrified) fossil. These fossils are formed from hard body parts. The most common petrified fossils found are formed from bones, teeth, claws or shells. Fossils of soft tissues are very rare because soft body parts don't petrify well. When a plant or animal dies, the soft parts quickly rot or are eaten. For this type of fossil to form, the hard body parts need to be gently and quickly buried by sediment. If the remains are buried rapidly after the animals dies, the parts are less likely to be eaten, decomposed or scattered around.

Over time, more and more sediment settles over the remains. After a long time, the materials in the buried animal's body undergo a series of changes. Replacement takes place. As the bone slowly dissolves, water filled with *minerals* seeps into the bone and replaces the bone with a rock-like material creating a fossil. This fossil has the same shape and size as the original object, but is harder and heavier because it is now made of minerals. The fossil will be the color of the mineral it is made of. This process can petrify wood, also.

Another type of fossil is formed when an organism is preserved. An example of this is when insects or plants are trapped in a sticky tree sap. The sap fossilizes into amber and preserves the organism. Entire animals have been preserved by being frozen. Preserved mammoths have been found in ice and frozen ground in parts of Asia and North America.



Fossil Skull



Insect in Amber

mineral : *a natural solid material that has a particular crystal structure*

preserved : *kept from harm or change*

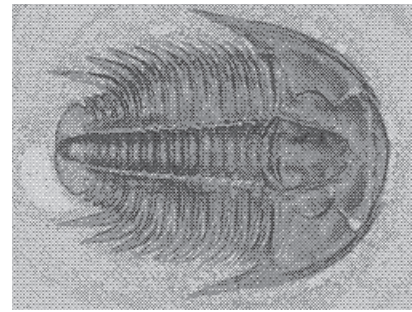
replacement : *the process of an organism's hard parts being dissolved and replaced by other minerals*

Have you ever wondered how fossils are found? Fossils are mostly discovered in *sedimentary* rocks on Earth's surface. Sometimes sedimentary and other kinds of rocks are forced upward by pressure inside Earth, forming mountains. These rocks are eroded by water and wind exposing the fossils. People who collect fossils go to these places. Here in Utah, there are many places where fossils have been discovered. Some are listed below. There are many types of fossils that have been found. Of course, some fossils will stay buried and remain undiscovered.

Counties	Types of Fossils	Ancient Environment of Fossils and Organisms
Millard County	Trilobites	Shallow seas
Box Elder County	Trilobites	Shallow seas
Tooele County	Sea lilies, seashells, coral	Shallow seas
Iron County	shells	Shallow seas
Garfield County	Mollusks (snails)	Warm, moist land environments
Uintah County	Dinosaurs' skeletons and footprints	Warm, moist land environments
Grand County	Dinosaurs such as Utah Raptor, dinosaur tracks	Warm, moist land environments
Wayne County	Petrified wood, dinosaur tracks	Warm, moist land environments
Sanpete County	Mammoth	Cold climate, most recent fossils
Summit County	Saber-toothed cat	Cold climate, most recent fossils
Washington County	Dinosaur footprints	Warm, moist land environments
Emery County	Dinosaur skeletons and eggs, Allosaurus	Warm, moist land environments

sedimentary : *formed from mud, sand, small pieces of rock, or other sediments that are pressed and naturally cemented to form a rock*

Fossils are compared to other fossils to see if they belong to a certain family of organisms. If a match is not found, there is a possibility that an unknown type of organism that existed long ago has been discovered. Scientists also like to see if the fossil they found is like any of the organisms that exist today. They compare leaf patterns, shapes, sizes, and structures of skeletons. Some match but many do not. If they don't, then those organisms have become *extinct*.



Extinct Trilobites

Several extinct organisms have been found in Utah.

Trilobites are probably the most common fossils collected in Utah. They range in size from as small as a dime to as large as a dinner plate. One set of extinct animals you've



Allosaurus Skeleton

probably heard about are *dinosaurs*. But how do we know so much about them if they are extinct? It's because trace and petrified fossils of dinosaurs have been found in Utah. There are several dinosaur quarries in Utah. Dinosaur National Monument in Uintah County is one of the sites. This site has produced several complete dinosaur skeletons as well as thousands of bones including fossils of sea creatures that are two or three times older than the dinosaurs. The Cleveland-Lloyd Dinosaur Quarry in Emery County is one of the world's most important sources of

dinosaur fossils. Two-thirds of the petrified bones uncovered there are from the Allosaurus. The Allosaurus is Utah's State Fossil.

We have learned a great deal about how fossils are formed and where they are found in Utah. Now like a great detective, we need to take these clues from Earth's history and use them to make inferences about Utah's past. The environment of Utah long ago was very different from what it is today.

Using the fossils found in various locations of Utah, we can infer how Utah's environments have changed over time. We can infer that much of Utah was once covered with a shallow sea. We can determine this because many sea-life fossils have been found in Utah, including trilobites. Fossils of coral have also been found in our state, and coral only lives in warm, shallow bodies of water.

Dinosaur fossils and coal fields help us infer that parts of Utah were once *tropical* and swampy. These were conditions suitable for dinosaur life. Dinosaurs could not live in the dry environment of today.



Prehistoric Environment

dinosaurs : *an extinct organism*

extinct : *no longer exists*

trilobite : *an extinct ocean shellfish*

tropical : *very hot and moist climate*

Fossils also help us to infer why dinosaurs and other organisms became extinct. Fossils tell us that there was a mass *extinction* at the time of the dinosaurs. They died out about 65 million years ago, along with more than half of all the other animal and plant species. There are several ideas about what caused the extinction. All these ideas are based on fossil evidence. There are four possible explanations scientists think may have caused dinosaur extinction.



Asteroid Impact

Some scientists think that a giant asteroid hit Earth. This resulted in a change in the *climate*. A dusty, gaseous smoke cloud was created, causing sunlight to be blocked. This caused dark and cold periods. Without sunlight, plants could not survive. Without plants, dinosaurs could not survive. Other scientists think that many huge volcanoes erupted, creating a cloud of smoke, dust, and ash which blocked the sunlight causing a change in the climate. The temperature cooled and plant production dropped. Dinosaurs and many other organisms died. Others think that the climate change was a result of moving continents and changes in the environment. Climates became cooler and drier. Less food was produced and the dinosaurs died.

Dinosaurs may have starved and died because other smaller mammals ate the same food as dinosaurs ate. Over time there were more small mammals than dinosaurs. These small mammals also ate the dinosaur eggs.

It may have been one of these events or many of these events together that caused the extinction of dinosaurs. The exact cause may never be known, but as more information is gathered from fossils, ideas change and we can come closer to finding out what really happened.

Fossils show us that life on Earth has changed. Fossils tell us about past environments. We can find out which parts of the world were once colder or warmer than they are now. We know where rivers, lakes or seas once existed. A piece of sandstone with wave-like ripples lets us know that a beach was once located here. We can find out how long ago some plants and animals lived and how they lived and died.

Fossils are the record keepers of Earth. Not all the records are easy to read. Some may be lost, others may be just a part of a record, but still they provide clues to what happened in the past and why Earth is as it is today. Working as detectives, we can look at the clues, put the pieces together and infer what happened in the past.

climate : a pattern of weather over a period of time

extinction : loss of an entire type of organism

Science Language that Students Should Know and Use

1. **climate:** a pattern of weather over a period of time
2. **dinosaur:** an extinct organism
3. **environment:** the surroundings and conditions in which an organism lives
4. **extinct:** no longer exists
5. **extinction:** loss of an entire type of organism
6. **fossil:** the remains or evidence of an ancient organism
7. **impression:** a mark or design made on a surface by pressure
8. **infer:** a process of reasoning from something known or assumed
9. **mineral:** a natural solid material that has a particular crystal structure
10. **organism:** a living thing that carries out basic life functions on its own
11. **prehistoric:** belonging to a period of time before recorded history
12. **preserved:** kept from harm or change
13. **replacement:** the process of an organism's hard parts being dissolved and replaced by other minerals
14. **sedimentary:** formed from mud, sand, small pieces of rock or other sediments that are pressed and naturally cemented to form a rock
15. **trilobite:** an extinct ocean shellfish
16. **tropical:** very hot and moist climate