PAST LIFE

Teacher Guide
including
Lesson Plans, Student Readers, and More Information

Lesson 1 - Present is Key to the Past

Lesson 2 - Fossilization

Lesson 3 - Present Day Organisms (Lab)

Lesson 4 - Fossils (Lab)

Lesson 5 - Ammonites

designed to be used as an Electronic Textbook
in class or at home

materials can be obtained from the Math/Science Nucleus

EARTH SCIENCES - PAST LIFE

Lesson 1 - Present is Key to the Past

MATERIALS:

reader

Objective: Students define a fossil.

Teacher note

Paleontology is not just about fossils. "Paleo" means old, and "onto" means life, so paleontologists study not only the remains, but how that organism lived in their environment. The oldest unmistakable fossils are about 3.8 billion years old. However, multicellular organisms did not appear in the fossil record until approximately 650 million years ago. Animals with hard body parts (skeletons) did not appear until about 580 million years ago.

In these units we will emphasize how fossils were formed and how they can be recognized. Geologic time and how we use fossils in the petroleum industry will be discussed in other units.

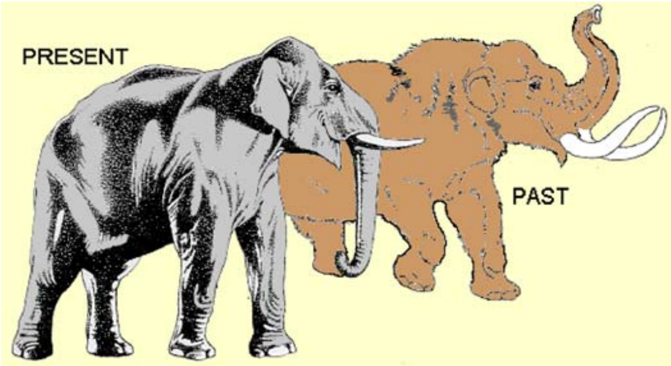
Below are some websites that can help you or your students learn more about fossils.

The University of California Paleontology Museum. A good link for detailed information about fossils, ancient life, the geologic time scale, and evolution.
http://www.ucmp.berkeley.edu/exhibit/exhibits.html

The online version of "Fossils, Rocks, and Time" an introductory brochure from the U.S. Geological Survey.
http://pubs.usgs.gov/gip/fossils/

A detailed introduction to geologic time, aimed at kids.
http://www.cotf.edu/ete/modules/msese/earthsysflr/geotime.html

Everything you wanted to know about dinosaurs, in detail.
http://www.dinosauria.com/fullindex.html



The “present is key to the past” is a simple but important statement in **paleontology**. Paleontologists look at present day organisms to help interpret fossils. “Paleo” means old and “onto” means life. Present day organisms help us to understand the life and environment of past organisms.

For example, a **paleontologist** finds a **fossil** skull of an organism with large, flat teeth. The skull is about 3 feet in diameter, with two large holes, where eyes would have been. Two broken objects come from the face, which were probably tusks. The paleontologist realizes that it probably belongs in the elephant family, because of the shape of the skull. However, the condition of the fossil with a brownish color, suggest that it is much older than a living elephant. It was found in rock layers that have been **age dated** to be of **Pleistocene** of age. The fossil may be a **mastodon** or a **mammoth**. Teeth were found and identified as belonging to a mastodon.


Mastodon tooth

Fossils are not always that easy to determine. From the time of the ancient Greeks until 1600's, fossils were thought to be oddities of nature. Shiny, button-shaped fossil teeth from fossil fish were thought to come from the heads of living toads. Clam fossils were hoof marks of recent sheep.

Fossils were also explained through myths and stories. **Ammonites**, a type of **extinct** sea animal, were believed to be coiled snakes turned to stone by a saint. The fossil tusk of the narwhal, a small whale, was for many years thought to be from the magical **unicorn**. Fossil oysters were nicknamed the Devil's Toenails.


Oyster fossil

When humans discovered there was a connection between fossils and now extinct species, it was a breakthrough in understanding the significance of fossils and geologic time.

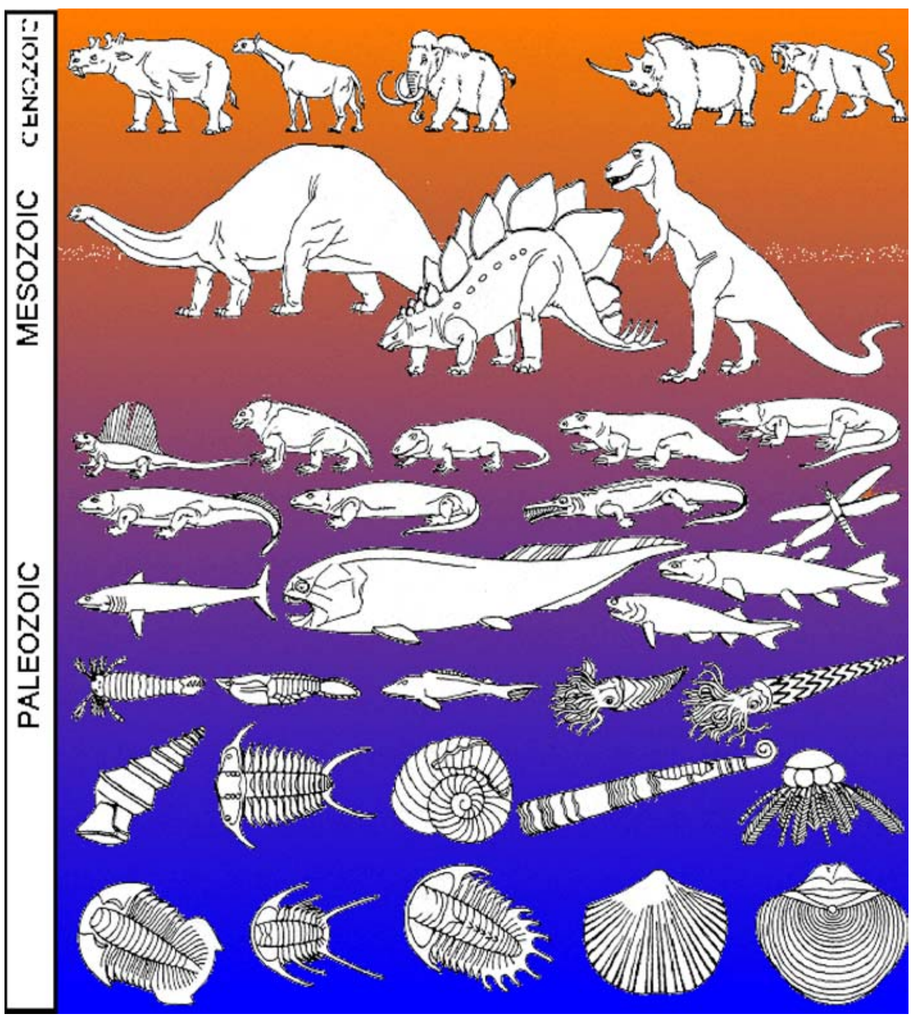

Living Narwhal


Ammonites

Geologic time explains how organisms have changed through time. Most living organisms are from the **Phanerozoic Eon**, which is divided into three **eras**: the **Paleozoic**, **Mesozoic**, and **Cenozoic**. Each era is characterized by different types of fossils. The diagram shows a simplified look at the organisms of each era.

In the Paleozoic (meaning "old life"), the first bony fish, amphibians, and reptiles appear. Mammal-like reptiles, are first found in the fossil record toward the end of this era. Land plants appear in the early part of the Paleozoic. The first plants were simple stick-like reeds. By the end of the Paleozoic, ferns and pine-like trees and **cycads** were the dominant types of plants.

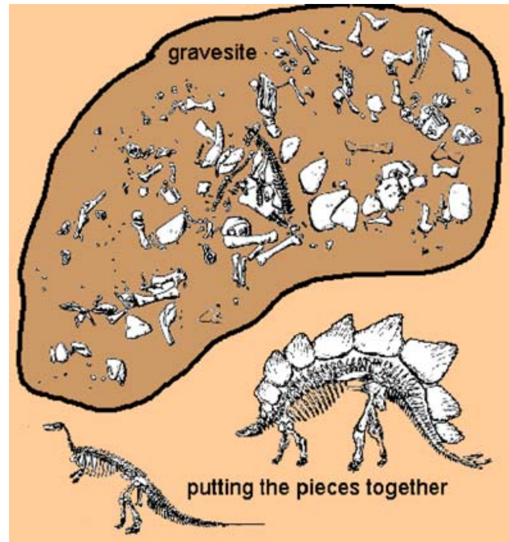
The **Mesozoic** refers to "middle" life and records abundant land organisms. Dinosaurs became abundant during the Mesozoic Era. True mammals and birds also appeared during this time period, as do the first flowering plants. In the **Cenozoic** Era, mammals became dominant, and grasses evolved. The earliest human ancestors first occurred about four million years ago.



Organisms through time

Fossils can provide more information than just the name of an organism. It can tell you how the organism became a fossil. When a land organism dies, its body is usually picked over by other animals and bones are scattered around. The bones can be eroded by different weather conditions.

A dinosaur grave site is like a crime scene. The paleontologist tries to interpret how the organism's remains came to this area. This is called the study of **taphonomy**. Paleontologists can determine if the bones were transported or whether the organism died at that site. Finding an entire skeleton of a land organism is rare, especially the large dinosaurs and mammals.

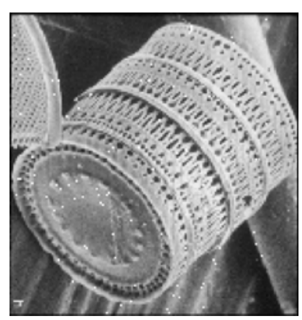


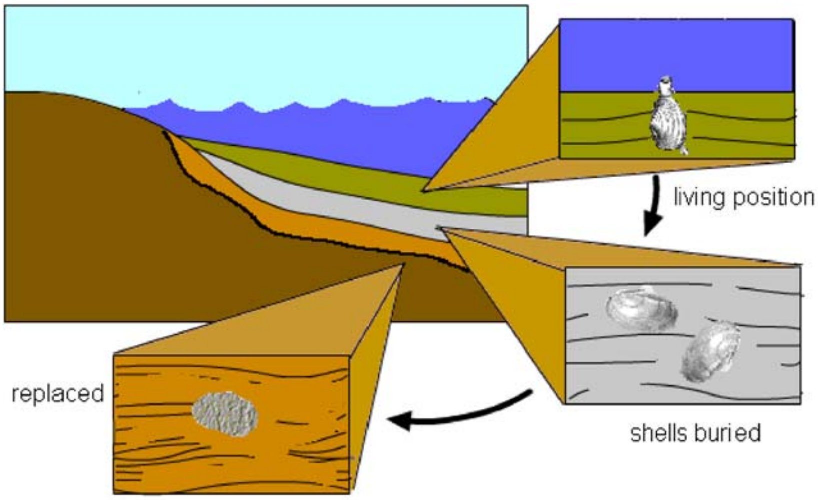
A dinosaur gravesite


Jellyfish would not be preserved, but the shells in this picture could become a fossil.

Not all organisms become fossils. Trees and other land plants are preserved under unique conditions. However, the **pollen** of plants (about 10-30 **microns** in diameter) has a hard coating and because they are small, can be buried and preserved. Organisms like fungi and bacteria are not preserved well at all. They are delicate organisms without a hard covering.

In the Animal kingdom, the **invertebrates** are best preserved if they live in or around water and have a hard shell. A jellyfish would not be preserved because it has no hard parts. Marine organisms are preserved the best. One celled critters with shells are well preserved in the fossil record. Protists have common marine critters, especially **radiolarians** and **foraminifera** that are very well preserved. One celled plants, diatoms, **silicoflagellates** are also well preserved because they have a hard shell made of opal (silica dioxide).


Diatom



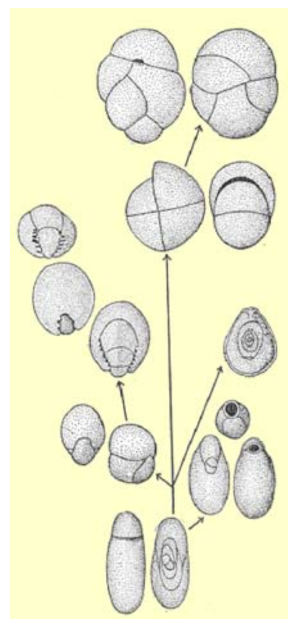
Fossilization process

There are three major conditions that allow organisms to become a fossil. The organism itself must have hard parts. The environment where it comes to rest must be covered with fine-grained sediment, like mud, rapidly. The fossils only represent a small fraction of the biological life that the fossils come from.

As the fossil is buried and becomes a rock, the conditions that a rock goes through will on whether the fossil will be recognized. For example, if many shells are preserved in a sedimentary rock, they will probably be preserved. But if the area is metamorphosed, then the rock will change and you may never know there were fossils buried in the rock.

Horseshoe crab

Fossils are clues to the type of organisms that roamed or swam on the Earth. However, fossils provide us with more information. They can tell us about the **paleoecology** or the relationship between organisms and their environments, if we can decipher the clues. Paleontologists want to determine the physical, chemical and biological interactions that can limit the distribution and abundance of different species. They are always searching as to why an organism may have gone extinct. Today we know that when an organism's environment changes or when other organisms invade another habit, extinction can occur.


Foraminifera change through time

Fossils also indicate that organisms have changed through time. As we learn which fossils lived in what time, we can retrace how the environment looked and assign periods of time to each fossil group. Horseshoe crabs for instance have not changed since they were first recorded in the fossil record. **Foraminifera** a protist, changes shapes through time and help geologist age date rocks.

EARTH SCIENCES - PAST LIFE

Lesson 2 -Fossilization

MATERIALS:

reader

Objective: Students learn the different types of fossilization.

Teacher note

There are two main types of fossil preservation. with alteration and without alteration. With alteration includes:

A) Carbonization, a chemical reaction where water transforms the organic material of plant or animal to a thin film of carbon.

B) Permineralization or petrifaction takes place in porous materials such as bones, plants and shells. The material is buried and groundwater percolates through its pore spaces and precipitates minerals in the spaces. The original wood or shell like material preserved.

C) Recrystallization changes the internal physical structure of a fossil, because it changes the microstructure of the original minerals. The composition of the mineral does not change, only the crystal structure. For example, many shells originally composed of calcium carbonate in the form of the mineral aragonite recrystallize into the more stable form of calcium carbonate called calcite.

D) Replacement involves the complete removal of original hard parts by solution and deposition of a new mineral in its place. The Petrified Forest in Arizona is an excellent example of this type of preservation. Here the original organic material (wood) has been wholly replaced by silica.

The second type of fossil creation is direct preservation, the preservation of fossils without alteration. The most common directly preserved fossils are unaltered hard parts of a living organism, like shells, teeth, and bones. This material is unchanged, except for the removal of less stable organic matter. Other examples of this type of preservation include fossil corals, shells, sponges, microscopic fossils and a host of other organisms with hard parts. In rare circumstances, preservation of the soft parts of an organism may occur.

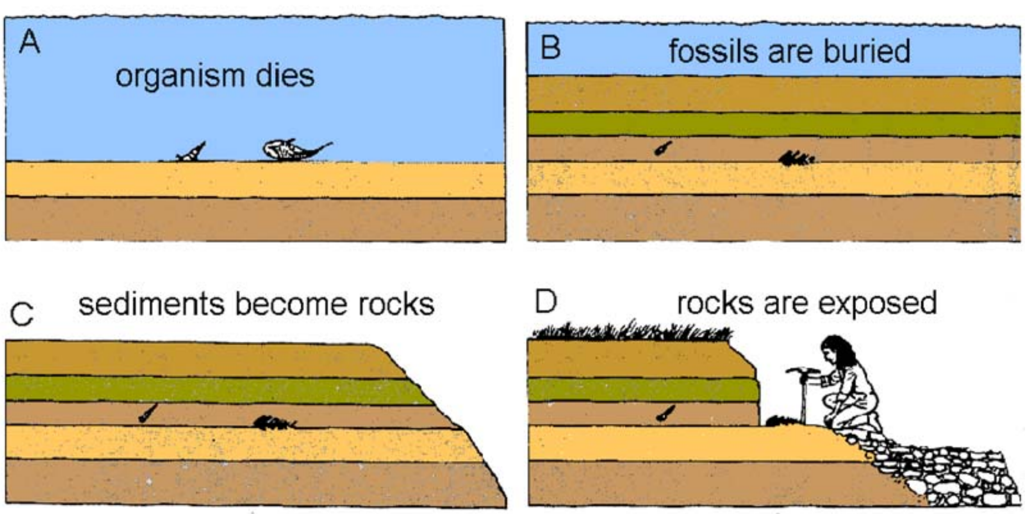
Paleontologists can also study past life using indirect evidence about how the one. Types of indirect evidence include molds and casts, tracks and trails, burrows and borings, and coprolites.

The **probability** that an organism will become a fossil is rare. The critters of long ago, could not go to a Paleo-Photo Shop to take pictures to record their **ancestry**. So we don't have an actual record, just old body parts!

Fossils may record direct or indirect evidence about their past life. Direct fossil evidence is any remaining part of an ancient organism. **Direct evidence** includes the preserved or altered hard parts of organisms, such as bones or shells. Preserved soft tissues, for example skin or feathers, are also a type of direct evidence. **Indirect evidence** is information about how ancient life lived. It includes such things as the footprints of ancient animals, or even coprolites (fossilized dung)!

Bone fragment is direct evidence

Paleontologists study how fossils become preserved. The chance that an organism will be preserved as a fossil is low. When an organism dies, its body decays and the skeleton falls apart. The soft tissues, such as the skins of animals or the leaves of plants, are usually destroyed. They break down into simpler chemical compounds. Hard body parts, such as bones, are much more likely to be preserved. However, they often become separated and broken into pieces. Geological processes such as **erosion**, **weathering**, and **sedimentation**, constantly destroy fossils before anyone sees them.



Ant in amber

Direct fossil evidence includes fossils with no alteration and fossils with alteration.

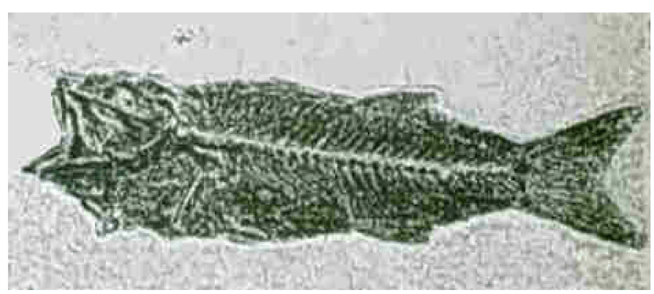
Fossils without alteration are rare. The original **organic** material is preserved without any chemical changes. The most common types of unaltered fossil are the hard parts of a living organism, like shells and teeth. In rare circumstances, preservation of soft parts may occur. An example is Dimo, a baby mammoth found in the tundra of Siberia. The ice preserved the mammoth's body parts. Preservation was so good that paleontologists were able to determine that the baby mammoth died of blood poisoning. Another example is an insect which has been trapped in tree resins. When the resin fossilizes to form **amber**, it preserves the insect.

A mammoth from Siberia

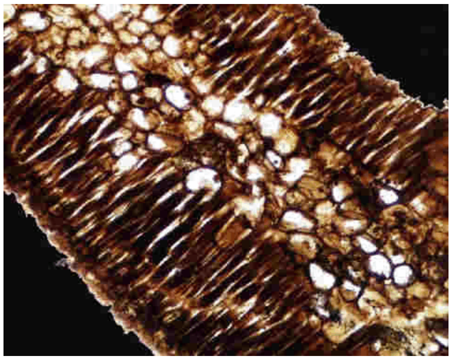
The most common type of fossil preservation is with alteration. The original organic material is partially or totally changed into new material. There are four common types of preservation with alteration including **carbonization**, **permineralization**, **recrystallization**, and **replacement**. These processes involve a chemical reaction with the organism and its surrounding.

Carbonization is a chemical reaction when water transforms the organic material of plant or animal to a thin film of carbon. Nitrogen, hydrogen, and oxygen are driven off as gases, leaving an outline of the organism. Organisms often preserved by carbonization include fish, leaves and the woody parts of plants.

Carbonization of leaves



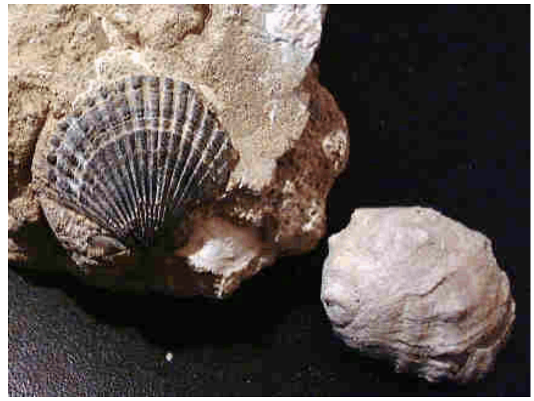
Carbonization of fish fossil



Permineralization of a stem

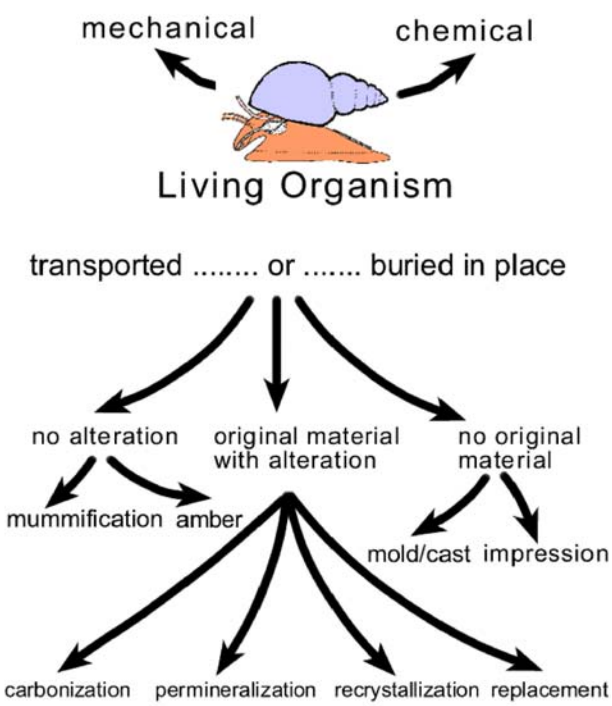
Permineralization preserves porous materials such as bones, plants and shells. The material is buried, then water percolates through it. A solution, commonly containing a lot of either calcium carbonate or silica, precipitates minerals in the spaces. The original wood or shell like material is preserved.

Recrystallization forms fossils out of bones and other hard parts that are made from minerals. In this process the minerals recrystallize. They regrow to make new, often larger crystals of the same composition.



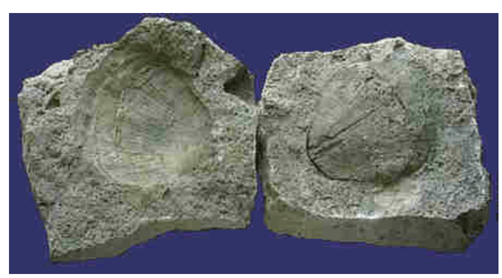
Replacement of mollusk fossils

Replacement involves the complete removal of the original hard parts. The original minerals dissolve in water. They are replaced by precipitation of new minerals. The Petrified Forest in Arizona is an excellent example of this type of preservation. The original organic material (wood) has been replaced by **silica**.



Routes of preservation

Indirect fossil preservation includes traces or clues of an organism's life. The most common indirect fossils are molds and casts. After the remains of an organism have been buried in sediments, water moving through the sediment dissolves the fossil. A cavity in the rock remains and is called a mold. A cast forms when the mold fills up with another material. In some cases minerals such as calcite or quartz precipitate in the mold. Sediment may also fill the void. The formation of a cast is similar to putting Jell-O in a mold. When you remove the mold, you are actually eating a cast.



Mold and cast

Tyrannosaurus rex tracks

The other types of indirect evidence are collectively called **trace fossils**. Trace fossils are not actual parts of an organism. Instead, they are some evidence of the organism's behavior. There are three main types of trace fossils. **Tracks and trails** are produced by an organism walking, crawling, **foraging**, or resting. For example, dinosaur tracks provide information about how large the dinosaur was; how fast it walked; and whether it walked alone or in a group. **Burrows and borings** are the tunnels or burrows left by organism digging into the ground, either on land or underwater. This may indicate whether the animal was feeding, dwelling, or just foraging. Finally, **coprolites** are fossilized animal excrements. They give some indication of the structure of the animal's gut, and sometimes provide clues to its diet.

Coprolite

EARTH SCIENCES - PAST LIFE

Lesson 3 - Present Day Organisms (Lab)

MATERIALS:

reader
Past Life - Present Kit
hand lens or microscope

Objective: Students observe and record information from recent organisms.

Teacher note

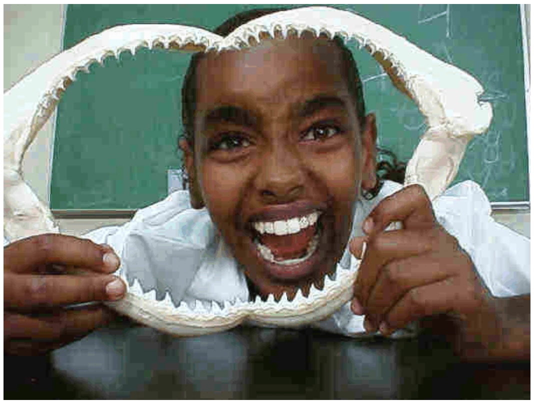
This lab provides materials so students can observe organisms that have hard parts. Remember the specimens students are looking at are dead, so the fleshy part is missing. You need to emphasize with students that the living organisms could look very differently.

The skeleton or hard part of an organism may sometimes look different than the organisms itself, other times it provides real clues to the living habitat of that organisms.

Use hand lenses or field microscopes to look at the specimens in detail.

Answers:

1. The shark jaw will disintegrate, but the teeth will be preserved
2. The shell is fragile, unless it is buried and the inside filled, it would not be preserved
3. The entire shell will be preserved, the color would not
4. Same as above
5. The segments would fall apart and the crab parts would disintegrate
6. The entire coral would be preserved
7. The spine will probably be preserved, but only represents part of the entire body
8. Each shell will be preserved but the likelihood of it being together is rare; one shell will probably become unattached
9. The shell will be preserved
10. Unless the sand dollar is buried rapidly in fine sediment, it will probably break and only be preserved as fragments.



Shark jaw

Only certain living organisms have what it takes to become a fossil. The requirements include having a hard shell and living in or near mud. The mud acts to protect the hard parts when the organism dies. If the hard part is buried rapidly, that helps its chances of becoming a fossil.

In this lab you will look at several organisms and determine the likelihood of them becoming fossils. Not all organisms have hard parts. They are some of the largest groups of organisms, like insects and worms, and they do not have many fossil counterparts.

Some organisms like sharks, only have teeth that are hard enough to be preserved. Every time a shark bites, they lose a set of teeth. But there are plenty rows of teeth behind to make sure the teeth are sharp for the next bite.

Crab

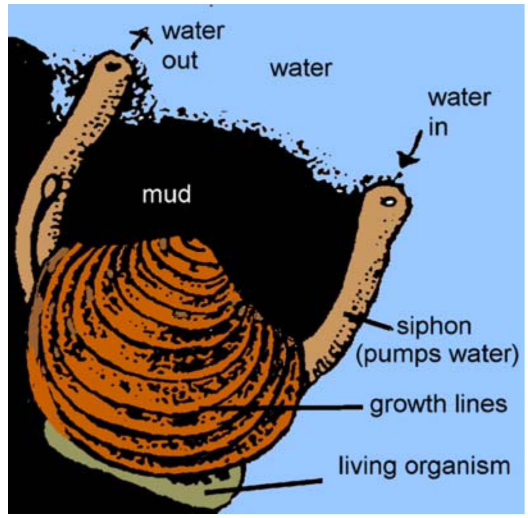
There are more species of arthropods than any other group in the world, but many do not have a hard part that can be preserved. You probably have eaten crab and had to tear or crack the shell. The material that many arthropods cover themselves with is not bone, it is a material that will break down easily.

Arthropods have a problem when they grow. Their shell does not grow with them. They must get rid of the old skeleton and replace it with new one (called **molting**). If you walk on the beach, many times you see these small"dead" crab shells, but they are only successive molts as the arthropod gets larger.

Some arthropods do have a hard part but it is more like a home than part of its living body. A barnacle is a marine organism that lives along the coast or attaches itself to rocks and even boats! It has a home composed of shell material, where the shrimp like creature lives. This home allows the barnacle to close its doors and can survive for a short time without water. When the animal dies, the house is the only remaining clue of its life.

Barnacle


Razor clam, designed to burrow quickly



Bivalve life position

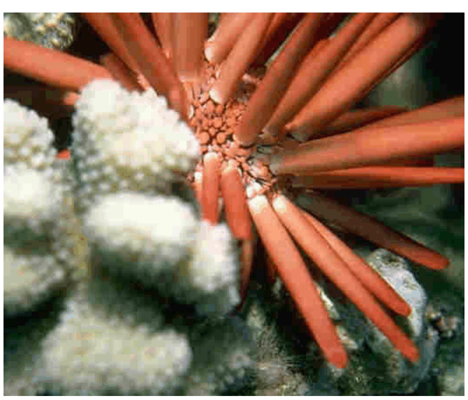
The phylum Mollusca is a very diverse group that includes clams, snails, and octopus. The groups with hard parts are found in today's oceans, lakes, and rivers include gastropods (snails) and bivalves (clams). Gastropods have **spiral** symmetry while bivalves have two shells that are bilaterally symmetrical.


Marine snails

The shells of bivalves can provide information on how the clam lived. Many bivalves adapt to their muddy and sandy lifestyles.

Cnidaria are organisms with a central stomach surrounded by stinging cells on the end of finger-like projections (**tentacles**). This phylum includes jellyfish, sea anemones, and corals. Coral heads are the skeletal remains of living corals. They are rough in texture and come in a variety of shapes, sizes, and colors. Corals can be either solitary or colonial. The colonial ones build large reefs. Each hole contains a single organism (**polyp**) that all live together.


Coral polyps with crab


Sea urchin on top of coral

Corals can be recognized by holes, rough textures, radiating walls or branches, and are mostly white when dead. Coral may form large reefs, like the Great Barrier Reef in Australia, which serve as homes and shelters for fish and other sealife.

Sand dollars

Echinoderms consist of animals that have a 5-arm pattern, sometimes brittle bodies, and circular holes that allow the entrance and removal of food and waste.

Some echinoderms like seastars, would probably not be preserved, but others like sea urchins or sand dollars have a greater chance because they have hard parts. Since sand dollars live in mud, its chances are the greatest. Sea urchins live along rocks and when they die, their spines become detached and then fossilized.

Sea urchins

EARTH SCIENCES-PAST LIFE

PRESENT DAY ORGANISMS - WHAT WILL BE FOSSILIZED?

MATERIALS: PAST LIFE: PRESENT KIT, hand lens, Swift-GH microscope

PROBLEM: Can you predict what portion of a living organism will be fossilized?

HYPOTHESIS:

PROCEDURE: Look at the specimens, each of which are the remains of a living organism. Try to determine what parts of each specimen are likely to become fossils. One good way to see details is by drawing. First draw the organism on another sheet of paper. When you have finished your drawing, describe what portions of the organism are likely to be preserved as fossils.

ORGANISM	DESCRIPTION
1. shark jaw (Vertebrate)	
2. *Nautilus* (Mollusca)	
3. *Babylonia formosae* (Mollusca - Gastropod)	
4. Sun dial (Mollusca - Gastropod)	
5. crab (Arthropod)	
6. mushroom coral (Cnidaria)	
7. sea urchin spines (Echinoderm)	
8. *Spondylus smensis* (Mollusca -Bivalve)	
9. white clam (Mollusca -Bivalve)	
10. Sand dollar (Echinoderm)	

EARTH SCIENCES - PAST LIFE

Lesson 4 - Fossils (Lab)

MATERIALS:

reader
Past Life - Fossils

Objective: Students look at fossils and compare with living organisms.

Teacher note

Fossils can fascinate students when the life and times of the organism are discussed. Having students use their imagination to reconstruct the organism's last seconds of life brings the specimens to life. Fossils without explanation become just rocks.

Your answers will depend on the specimens in the lab. Observation and recording of these observations is important.

Trilobite

In this lab you will read information about each fossil and then answer the questions relating to that fossil. Remember fossils are, many times, just a portion of the entire organism. You have to use your imagination to visualize the organisms in its setting before its final grave. Some of these organisms may have gotten buried during a storm, which ripped up mud and buried them alive. Some fossils may have been some other organism's last meal. You will look at several large groups that were abundant as fossils in the past.

Fossil gastropods

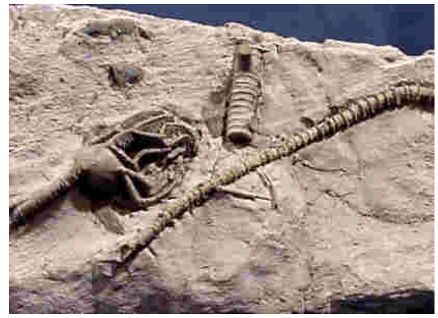
Belemnites

Trilobites are related to the present day arthropods, but they are now extinct as a group. They use to be very abundant in shallow marine environments and are a symbol of ancient life in the Paleozoic.

Mollusks are not only abundant today, but were in the past. However, the forms that were abundant in the Mesozoic like ammonites and belemnites look different from the clams and snails that are abundant today. One of the fossils, a gastropod resembles the snails of today.

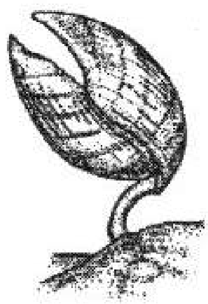
Brachiopod

Brachiopods are present today, but are not common in the deep marine. In the past, especially in the Paleozoic they were very abundant. They resemble clams, but they are not. The two shells of brachiopods are not the same, as in clams and the living organisms have a completely different lifestyle.



Fossil crinoid stems

Echinoderms are a large group that includes sand dollars and sea urchins. In the past, crinoids were abundant and littered the ocean floor. Today they are present, but not to the extend as in the Paleozoic.



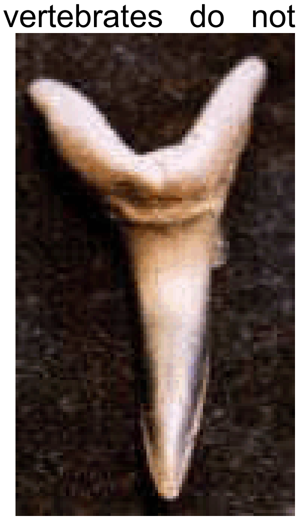
Living brachiopod

Living crinoid

The only vertebrate group represented in this lab is the fish group. Vertebrates are organisms with a backbone. Fish have a higher likelihood of becoming a fossil, because they can be preserved in fine grained sediments after they die. Many land vertebrates do not have conditions right for preservation. The carbonized impression of the fish shows details of the entire fish.

Fossil fish

The shark teeth only represent a small part of the shark, yet you can estimate the size of the shark. Big teeth come from big sharks. The abundance of shark teeth is caused by a shark discarding its teeth once it bites into something.



Shark tooth

EARTH SCIENCES - PAST LIFE

FOSSIL LAB

MATERIALS: PAST LIFE: FOSSILS, hand lens, Swift-GH

PROBLEM: How can you tell what kind of organism a fossil represents?

HYPOTHESIS:

PROCEDURE: Examine each fossil specimen and answer the questions about them. When you have finished, complete the fossil description chart (Question 10)

1. **TRILOBITE**
Trilobites were three lobed animals related to arthropods. They were marine organisms that ate debris that had accumulated on the bottom of the sea. They were a type of **deposit feeder**. Trilobites ranged in length from a few millimeters to almost 20 centimeters. Trilobites lived during the Paleozoic Era, between 545-220 million years ago.

A. What type of environment did trilobites live in? Because these organisms are now extinct, how can we tell what they looked like?

B. What living organism from the previous lab do trilobites resemble?

C. Sketch your trilobite.

2. **AMMONITE**
Ammonites lived during the late Paleozoic and Mesozoic Eras (395-65 million years ago), but are now extinct. Ammonites were a type of mollusk, belonging to the class of Cephalopods. Cephalopods are best known for their arms and tentacles. An octopus is a modern example of a cephalopod. Ammonites probably had eight to ten tentacles which they used to move about and to catch food. Your specimen is only the shell of the ammonite. The ammonite lived in the larger opening at the end of the shell. The shell acts as protection and enabled the ammonite to regulate its body pressure as it moved through different depths of water.

A. This ammonite specimen came from Morocco. Where is Morocco? Can you predict the type of environment in Morocco area when this organism was alive?

B. What organisms does this resemble from the previous lab? Why?

C. Sketch the ammonite.

3. **BELEMNITE** (*Orthoceras*)
Like ammonites, belemnites are a type of extinct cephalopod within the Mollusk group. *Orthoceras* is the genus name of a particular group of Belemnites. The ammonite you looked at is related to *Orthoceras*. The shell of the ammonite has a spiral shape, whereas the shell of *Orthoceras* is elongated. If you look closely at your specimen, you may be able to see the chambers within the shell where the organism lived.

A. Compare *Orthoceras* with the sea urchin spine that you observed in the previous lab on present day organisms. How are they similar? How are they different? Could you mistakenly believe these fossils are from related organisms? Why?

B. Sketch your *Orthoceras.*

4. **SHARK TOOTH**
This shark tooth is between 10 and 25 million years in age. The specimens are from Morocco. Every time a shark takes a bite, they eat their own teeth and whatever they bit into. Whey the shark "poops" the teeth are removed from the sharks systems and becomes a fossil.

A. Compare these specimens with the shark jaw that you saw in the previous lab. What are the differences and similarities? How big do you think this shark was?

B. Sketch your specimen.

5. **CRINOID STEM**

Crinoids belong to the phylum Echinodermata, which includes sea stars and sand dollars. Crinoids were diverse in the Paleozoic. They attached to the marine floor using a tree-like stem. The organism's main body which has arms radiating from its body, is attached on the top.

A. Compare the crinoid stem with the sea urchin spine. How are the two specimens similar, and how are they different? Could you mistakenly believe these fossils are from related organisms? Why or why not?

B. Sketch the crinoid stem.

6. **GASTROPOD** (*Turritella agate*)

Gastropods belong to the Phylum Mollusca. Their shells have a spiral symmetry, which makes them easy to recognize. In your specimen, the original shell material has been replaced by quartz (agate).

A. How do you know that these are fossil gastropods?

B. Why is the specimen shiny?

C. Sketch as many different gastropods as you can find in your specimen.

D. To which living organisms from the previous lab are these fossils most related? Explain.

7. **BRACHIOPOD**
Brachiopods were abundant animals in the seas of the Paleozoic Era. Starting about 200 million years ago, the Mollusk group took over their living spaces. Today, brachiopods only live in deep marine water, and are not abundant.

A. On the surface a brachiopod looks like a "clam." However, there is something different about the shells. What is the difference?

B. Sketch the brachiopod.

C. Which living organisms from the previous lab are these fossils most related? Explain

8. **FOSSIL FISH**
When fish die, their remains can settle to the ocean floor. If there is rapid burial, the fish will compress over time and a chemical change will convert the fish's organic body into a film of carbon that is like an outline of the living fish.

A. Make a sketch of the specimen. Make a second sketch of what you think it may have looked like when this fish was alive.

B. Why is the specimen brown?

9. **SEA URCHIN SPINES**
Sea urchins belong to the Echinodermata and has a typical five part symmetry. The spines help the sea urchin move and help protect the living organism.

A. Sketch the sea urchin spine. Point out which end was attached to the body of the sea urchin.

B. Does this specimen look similar to the sea urchin spine in the previous lab?

C. Could you guess what organism this belongs to if you didn't have a knowledge of the present? Explain.

D. What other inanimate or animate object could you confuse this with? (Use your imagination.)

10. Using your answers from questions 1 to 9, complete the chart below.

FOSSIL NAME	GROUP	DESCRIBE
trilobite		
ammonite		
shark tooth (Morocco)		
belemnite (Orthoceras)		
gastropod		
brachiopod		
fish		
crinoid stem		
sea urchin spine		

EARTH SCIENCES - PAST LIFE

Lesson 5 - Ammonites

MATERIALS:

reader

Objective: Students learn about the extinct ammonites.

Teacher note

Ammonites are an extinct group of cephalopods, which are grouped under the Phylum Mollusca. The living examples of cephalopods include squid, octopus, and Nautilus. This group is the most advanced group of mollusk.

Ammonites are amongst the most abundant and well known of fossils. They are important to identify rocks that were marine in origin and from the Triassic, Jurassic or Cretaceous.

There are many websites devoted to ammonites, including:
Pictures from the Pierre Shale. Pictures record beautifully the fossils that are present.
http://www.wmnh.com/wmima000.htm

We suggest you do a search on the internet, since most of these sites are from personal collections and tend to change location.

Some layers of sedimentary rock contain features called **concretions**. Concretions are masses of sediment that have been very tightly cemented together. Concretions are often very hard and resistant to weathering. They can occur in almost any shape, although rounded to disk-like shapes are very common. Many concretions form around organic material. Concretions thus often contain fossils.

A concretion in sedimentary rock

Ammonite shell inside of a concretion

If you were going for a hike, and were walking over sedimentary rocks, you might find a concretion. If these rocks were from Paleozoic or Mesozoic, you might be lucky enough to find a concretion that contains the beautiful fossil shell of an ammonite.


Fossil ammonite

Ammonites are extinct animals. They lived between 400 and 65 million years ago. They lived in the Paleozoic and Mesozoic oceans. Paleontologists classify ammonites as relatives of modern animals such as the squid, the octopus, and the nautilus. This group of organisms is called the Cephalopods, belonging to the Phylum Mollusca.

All cephalopods are invertebrate animals, or animals without backbones. In addition, the cephalopods all have chambered shells. Ammonite and nautilus shells have a **whorl** or plano-coiled shape. The shell of the ammonite is usually what is preserved as a fossil.


Living Nautilus


Two “uncoiled” ammonites

Based on the similar appearance of their shells, ammonites probably looked and behaved like modern nautiluses. The living nautilus has many (38 or more) tentacles, with which it catches food. The nautilus has small poorly developed eyes and a leather-like spotted hood. The nautilus animal inhabits the last and largest chamber in its shell. The animal grows new, larger chambers as it ages and grows bigger.

The shell of the nautilus protects the animal from predators. The nautilus can withdraw completely into its shell, almost like a turtle, and block the end of the shell with its hood. The nautilus uses the empty chambers in its shell to help maintain neutral buoyancy. This means the animal does not float or sink. The nautilus moves by “jet propulsion,” by blowing a stream of water out of a tube between its shell. The nautilus lives in the open ocean near coral reefs. It is a predator, eating shrimp and small fish.

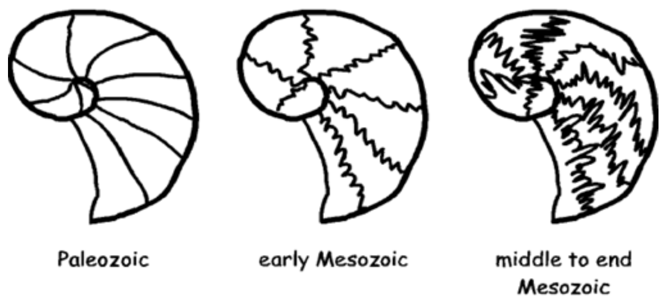

A nautilus shell - notice the smooth chamber walls

Ammonites were much more varied than nautiluses. For example, nautiluses grow up to 20 centimeters in diameter, while ammonites range in diameter from a few centimeters to more than 2 meters. In addition, the coiling of ammonite shells was variable; some fossil shells are "unrolled" or open coiled.

The walls of the chambers in ammonite and nautilus shells are very different. Nautilus chamber walls are simple smooth shapes. In contrast, ammonite chamber walls are very complex and intricate. They show arrangements almost like the stitching patterns in clothing. Paleontologists do not yet know why ammonite chamber walls were so complex. One idea is that it allowed the shells to be thinner and stronger. This may have allowed ammonites to move faster and swim deeper in the ocean.

An ammonite shell, with complex chamber walls

The variety of ammonite sizes, shapes, and structures suggests that they lived differently than nautiluses. Some ammonites may have lived near the sea floor, eating bottom-dwelling organisms or decayed organic material. Others, especially the large ammonites, may have been predators.



Judging from the patterns of their chamber walls, ammonites evolved quickly. This means that ammonite fossils are very useful for telling relative geologic time. For example, ammonites from the Paleozoic Era all have simple chamber wall patterns. In the first part of the Mesozoic Era, ammonites appear that have more complex folded chamber walls. By the middle of the Mesozoic Era, the patterns become very elaborate. A paleontologist can tell the age of a rock from just the ammonite fossils it contains.

Ammonite fossils are found in many places throughout the world. While they may seem unusual to us, in their time they were as common as fish in the oceans. Paleontologists do not know why ammonites became extinct. They vanished at the same time as the dinosaurs, about 65 million years ago. Their extinction may have been related to environmental changes due to the movement of the plates.

Fossil ammonite

Earth Science- Present and Past Life - Unit Test

Part I. Definitions Match the number of the term or concept in Column 1 with the letter of the correct definition in Column 2.

Column 1	Column 2
1. fossil	a. fossilized dung
2. ammonite	b. fossil formation by the precipitation of new minerals
3. replacement	c. fossil insects are commonly found in this substance
4. Cenozoic Era	d. the study of ancient life
5. burrow	e. fossil shell
6. direct evidence	f. a type of trace fossil
7. coprolite	g. any evidence of ancient life
8. amber	h. a type of fossil cephalopod (mollusk)
9. indirect fossil evidence	i. the most recent part of the Phanerozoic Eon
10. paleontology	j. track and trail impressions

Part II. Multiple Choice Choose the best answer to complete each statement.

1. Fossils may form from:
    a. the hard parts of organisms
    b. the soft parts of organisms
    c. the tracks and trails of organisms
    d. all of the above

2. Preservation of an organism depends on
    a. burial conditions
    b. temperature
    c. pressure
    d. pH

3. Which is not a type of preservation with alteration?
    a. permineralization
    b. recrystallization
    c. mold and cast
    d. carbonization

4. What type of indirect fossil evidence is like making jell-O?
   a. mold and cast
   b. track way
   c. burrow
   d. coprolite

5. A paleontologist found a tusk of a mammoth that was only discolored to brown. This type of preservation is called:
   a. preservation without alteration
   b. preservation with alteration
   c. permineralization
   d. recrystallization

6. The age of the earth is:
   a. 12 billion years
   b. 4.5 billion years
   c. 3.9 billion years
   d. 1 billion years

7. Animals have existed for about:
   a. 4 billion years
   b. 1.2 billion years
   c. 560 million years
   d. 4 million years

8. Trilobites lived during the _______ Era.
   a. Phanerozoic
   b. Cenozoic
   c. Paleozoic
   d. Mesozoic

9. Land organisms are important fossils in the
   a. Paleozoic
   b. Mesozoic and Cenozoic
   c. Phanerozoic
   d. PreCambrian

10. The Geologic Time Scale:
   a. divide fossils into groups
   b. is based on sedimentary rocks
   c. is based on the changes in fossils through time
   d. uses minutes instead of years.

ANSWERS:

Part I.

1. G
2. H
3. B
4. I
5. F
6. E
7. A
8. C
9. J
10. D

Part II.

1. D
2. A
3. C
4. A
5. A
6. B
7. C
8. C
9. B
10. C