LESSON #2: All Fossils are Not the Same: Different Fossils are Formed in Different Ways

Focus questions

1. How are fossils formed?
2. What environmental factors lead to a fossil being formed?
3. Why don't most plants and animals become fossils?

What students do in this activity

This is a three-part activity. In the first part, students will make a fossil using a sponge and salt water. This will need to sit for several days to let the fossil form. In the second part, students will make a fossil using plaster of Paris and modeling clay. In the third part, they will be given different scenarios and asked to speculate on the environmental conditions that led to fossilization of a plant or animal.

Estimated teaching time

Two class periods

Fossil drying time:

You may want to do the first part of this activity (with the sponge and salt water) a week before parts 2 and 3 to allow drying time. Continue parts 2 and 3 when part 1 has been completed.

General supplies to complete this lesson plan

Paper cups	Food coloring
Salt	Plastic Spoons
Scissors	Modeling clay
Paper	Plaster of Paris
Petroleum Jelly	Sponges (1" thick)

Each student will need the following

Part 1

Sponge (cut into 1/4" thick slices)
Food coloring (can be shared)

Hot water	Salt (can be shared)
Paper cup	Plastic spoon
Pencil	Scissors
Paper	Marker (can be shared)

Cottage cheese container or other plastic container (ideal is about 3-4 inches wide by 3-4 inches deep with a flat bottom) **Students will need a separate container for parts 1 and 2.**

Part 2

Shell or fossil
Petroleum jelly (can be shared by many)
One ball of modeling clay
Paper cup (if students mix own plaster of Paris)
Plastic spoon
Plaster of Paris (if students mix own plaster of Paris)
Water
Cottage cheese container or other plastic container (ideal is about 3-4 inches wide by 3-4 inches deep with a flat bottom) **Students will need a separate container for parts 1 and 2.**

Part 3

One drawing of Paleoenvironment to interpret

The Dawn of Diversity

LIFE IN THE BURGESS SHALE

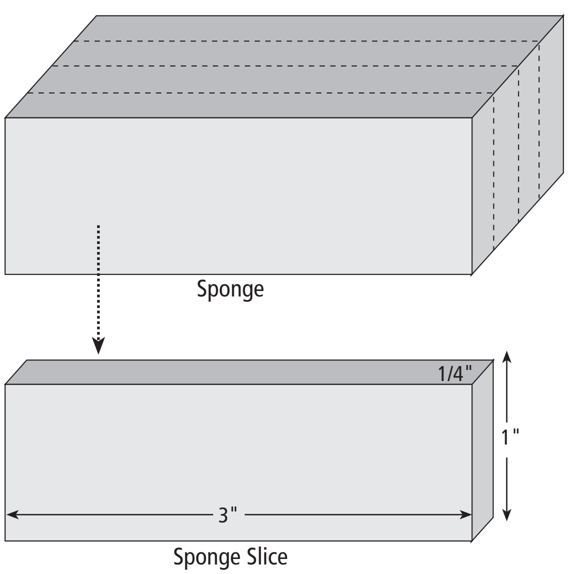
Learning goals

Students will:

1. Learn what a fossil and the fossil record are.
2. Learn how organisms become fossils.
3. Learn the factors that promote fossilization.
4. Learn why not all organisms will become part of the fossil record.

Advance preparation

1. Tell students they need to bring the following items to class: two cottage cheese or yogurt containers (they should by 3" x 4" inches); one shell or fossil, which can be broken if necessary.
2. Copy Paleoenvironment drawings (there should be enough so that each student in each group has one drawing)
3. Cut the sponge into 1/4” thick slices, as if you were cutting a loaf of bread. Each student should have a sponge roughly 1/4” thick x 1” high x 3” wide.



Facilitating the activity: Parts 1 and 2

Part 1

1. Pass out a sponge slice to each student and have them cut it into the shape of a plant or animal part. Be creative. How about a claw, shell, or bone? **They may want to practice drawing what they are going to cut on a piece of paper and then use a marker to draw the organism on the sponge. The sponge needs to be small enough to fit completely in the bottom of the student’s plastic container.**
2. Label their cottage cheese container with their name on the outside.
3. Place the sponge “organism” in the cottage cheese container.
4. Make the “mineral” mixture by mixing together hot tap water and salt in the paper cup. Keep adding salt until it no longer dissolves, roughly 4 tablespoons/cup.
5. If you want, add a few drops of food coloring, which simulates how different minerals create different colors in fossils.
6. Pour mineral water over the sponge until it is covered.
7. Place container in window or someplace where it has a chance to be warmed, such as over a heating grate. This will facilitate the water evaporating. Let sponge and mixture sit until water evaporates, possibly a week, depending on temperature.

Part 2

1. Pass out balls of modeling clay. Have students shape them into flat slabs in the bottom of a cottage cheese container.

2. Apply a thin coat of petroleum jelly or soapy water to the “fossil” so it won’t stick to the clay.

3. Place the “fossil” on the clay slab and press it into the clay. If the mold is not clean and sharp, smooth out the clay and repress the “fossil.” Remove the fossil.

4. Mix up the plaster of Paris and pour it into the mold.

5. Let the plaster of Paris dry.

Tip:
Mixing plaster of Paris can be a mess. One option is for the teacher to do it and pour it out into the molds. Since plaster of Paris dries so quickly, wait until all students are ready before making the mixture. You may have to make several batches.

Use cold water, as this slows the drying process.

Summarizing and reflecting of parts 1 and 2

The point of these first two activities was to show how fossils can form. The first illustrates a typical way that bones or trees are fossilized. Ask students to think about what would have to happen for a real bone to become fossilized in this manner — where minerals fill in the pores of the bone. (For this to happen, a bone would have to be covered by sediments and then have ground water rich in minerals, such as silica, percolate through the sediments, encounter the bone, and fill in the pores. This is known as *permineralization*.) A type of *permineralization* called *petrifaction* occurs when all organic material is replaced by minerals, such as happens in petrified wood.

The second experiment illustrates how hard parts, such as bones, teeth or shells, can leave an impression in sand and then later dissolve away. Again, ask students to think about what would have to happen for a hard part to become fossilized this way. (For this to happen, a tooth, for example, would get covered by a porous sediment such as sand. The porous nature of the rock enables carbonated ground water to permeate and dissolve the original tissue leaving a detailed mold of the organism.)

Facilitating the activity: Part 3

1. Ask the students to review how something gets fossilized.

2. Ask the students to form teams. They will be working together.

3. Tell the student teams that they are going be given one scenario where they have to imagine how a plant or animal or group of plants or animals became a fossil and was found by a modern day paleontologist. They also have to speculate how the plant or animal or group of plants or animals might not have become a fossil and how it might not have been discovered. Remind them that the overwhelming majority of individuals are not fossilized.

4. Hand out one of five descriptions. (More detail is included in the Teacher Background.)
   a. A rhinoceros-like animal lives on plains near volcanic activity
   b. A variety of invertebrates live at the bottom of shallow, warm sea
   c. Hordes of fish live in a large, shallow lake
   d. Horse, camels and pig-like beasts live in a savannah-like environment
   e. Forests of conifers and ferns grow in a floodplain

5. Have students take their scenario and create one situation where the animals or plants are fossilized and one where they aren’t fossilized. Have them either illustrate the successful fossilization process in cartoon format or write

a description of the process. The questions on each environment page should help guide them through the fossilization process.

Summarizing and reflecting of Part 3

- Ask the student groups to describe the environments they studied and to review how the plant or animal could or could not be fossilized. What surprised them about fossil formation in their particular environment?

- Ask the students to think about what they can learn from a cast versus a mold versus a permineralized bone versus a trace fossil. What can they learn from fossils such as those found in amber or tar?

- Ask the students to think about what paleontologists can learn about paleo-environments from fossils. For example, in the Burgess Shale there is a fossil of a trilobite with a bite taken out it, which paleontologists hypothesize was from a Anomalocaris.

- Given what they have learned about how fossils form, ask students where would they go to search for fossils?

Extensions:

Students could research additional Washington state fossils and trace their paths from life to fossilization to discovery. Examples might include whales on the Olympic Peninsula, Gingko Petrified Forest State Park, the giant sloth at SeaTac Airport, or mammoths in downtown Seattle. Students could try to find out where the closest fossils are to the school. They could investigate building stones to see if they can find buildings that have fossils in them.

Notes

TEACHER BACKGROUND

What are fossils, how do they form, and why are they so rare?

A fossil is the evidence of life on the planet. It may be the physical parts of a plant or animal, such as bones, teeth or leaves, or it may be an indication of biological activity, such as a burrow or track. Paleontologists use fossils to tell who lived where, what the climatic conditions were like, and the age of a particular layer of the Earth.

To illustrate the manners in which plants and animals fossilize, here are several well-known fossils and their paths from living organism to fossil.

Part of what makes the Burgess Shale so unusual is that the majority of the specimens preserve soft body parts. During their life, most of the animals of the Burgess lived on the sea bottom. One day, the cliff above their home collapsed, sending a wall of clay-sized sediments (a landslide or turbidity current, as underwater landslides are called) over the animals. The flow deposited them willy-nilly, some flat, some upside down, some upright. They were buried so thoroughly that no scavengers could reach them. Nor could oxygen penetrate the clay and start the decay process, though some decay did occur. More and more layers piled on top, and the soft body parts slowly hardened into carbon films, coated by silicate films, so that when paleontologists look at Burgess Shale fossils, they generally see a highly detailed film of a flattened animal.

In contrast, the *Tyrannosaurus rex* known as Sue is a massive collection of fossilized bones. Her story begins 67 million years ago when she died along a river bank in what is now South Dakota. Soon after her death and before scavengers could find her, a flood washed her rotting body down river and covered it with sand and mud. Over the millennia, sediments continued to build atop her body, forcing mineral-rich water through every pore of her bones. Eventually the minerals filled in every space in the bones, forming heavier-than-bone, rock-hard fossils, a process call permineralization. This process also creates petrified wood.

Bones or shells can also be replaced by other minerals. Trilobites lived 445 million years ago in a sea that experienced avalanches of sediments. After burial of the organisms, microbes began to feed on organic matter, producing sulfates as a byproduct. The sulfur mixed with iron in the sediment to form the mineral pyrite, or fool's gold, which replaced all of the organic parts of the trilobite exoskeleton. These golden fossils, known as Beecher's trilobites, occur near Rome, New York.

Animals occasionally make missteps, which can lead to their later fossilization. Probably the most famous of these locales is the La Brea Tar Pits, in Los Angeles, where millions of mammals, birds and insects were trapped in pits of asphalt, or tar, 40,000 years ago. Many of the animals are in pristine condition. Another well known group of fossilized animals is found in amber, the hardened resin or sap of trees. For example, in Europe between 35 and 50 million years ago, grew extensive forests of an extinct tree, *Pinus succinifera*. Gooey resin oozed from the trees trapping many insects such as flies, beetles and wasps. When the resin hardened into amber, it perfectly preserved the organisms.

All of the above manners of fossilization are rare. Paleontologists are interested in them because of their unusual nature. During a typical fossilization process, the soft parts do not survive because decomposers get to them or they are squished beyond recognition by overlying sediments. Even when hard parts are fossilized, it is rare to find such a complete skeleton as was found with Sue. More often only a few bones or their broken remains are found as fossils.

Another fossilization process occurs when an organism only leaves an impression of itself. For example, an organism can be totally or partially buried in sand that hardens into rock. Over time, groundwater may dissolve the organisms, leaving a cavity, often called a mold, shaped like its body. If mud or minerals later fill the mold, the hardened filling is called a cast, which looks like the organism itself, not like its imprint.

In the overwhelming majority of cases, most plants or animals never fossilize — nor are they found later by scientists. Consider a hypothetical bird that lived millions of years ago. It dies next to a stream. The day after it dies, a flood comes down, carries the bird away, and destroys all of its bones. Or, instead of a flood, a hungry mammal trots by and eats it, leaving its bones for other scavengers to break up or for worms to decompose. Or a nearby volcano erupts, sending a cascade of lava down, which buries the bird. Or a small flood hits and carries the bird to a bend in the stream, where over the next months it slowly decomposes and gets covered by more sands.

Over thousands of years, more and more sediment piles atop the bird and it slowly becomes a fossil in a layer of sandstone. More time passes, and this layer is uplifted and exposed to the elements. Erosion takes place and the fossil gets exposed at the surface. It remains on the surface until a flood arrives and carries it down river and out into the ocean. Or another volcano erupts and buries the freshly exposed fossil. Or 10-year-old Charlie Smilodon finds the fossil and takes it to the museum where his mother is the Curator of Paleontology. She recognizes it as an ancient bird, labels it and puts it on display.

In another scenario, just down stream from the bird grows a grove of willows. The nearby volcano blows, but this time it spews ash instead of lava. The ash settles around the trees, which die and decay, leaving a cast of the trunks. Over time, the region gets covered by more sediments, which fill in the casts of the trees forming a perfect mold of the tree. In this same scenario, just before the volcano blew, several birds had been wandering about in the muddy shore next to the stream, leaving behind their foot prints. The ash lands, covers their tracks, and preserves them. These non-body remains of biological activity are called trace fossils.

Notes

Worksheet answer key

PALEOENVIRONMENT 1: Blue Lake Rhino

In 1935, a group of hikers discovered one of Washington's most famous fossils near Blue Lake, a few miles south of Dry Falls in eastern Washington. The Blue Lake rhino fossil includes a few bone fragments and partial jaw found near a natural mold of the creature formed when the dead rhino was engulfed by a lava flow. The mold is preserved in pillow basalt overlying a thin sand bed. The rhino probably lay dead in a small pond when lava flowed into the water and hardened, forming a mold around the bloated body.

In the late 1940s a crew from the University of California at Berkeley made a cast of the interior of the mold using jellied soap to coat the interior of the mold, then making sector casts of plaster, which were removed through the tail orifice and reconstructed. The animal was on its back, feet outstretched to the sky, when it died. A copy of this mold of the Blue Lake Rhino is at the Burke Museum.

This example was chosen because it is from Washington state and is a particularly spectacular example of a fossil mold. It is also unique. There is no other mold like this and thus it does not illustrate the typical mold process, which is described above. This is a key point to make for the students.

For those interested in more information about the Blue Lake Rhino, please consult: Kaler, Keith L., 1988. The Blue Lake rhinoceros. Washington Geologic Newsletter 16(4): 3-8

Answers to questions asked of students on Paleoenvironment 1 handout

1. Could this rhinoceros have been fossilized? **Yes**

2. What clues do you get from the plants, such as the willows and cattails, that lived near the rhino? **These plants indicate the presence of permanent water, which is what led to the preservation of the rhino.**

3. If so, would it be likely to preserve the bones and teeth, or do you think only a mold would have been preserved? **A few bones and teeth did fossilize.**

4. If so, do you think that a rhinoceros preserved in basalt (hardened lava) is unusual in the fossil record? **Yes.**

5. If not, why wouldn't the rhinoceros have survived? **Basalt would have burned the rhino.**

PALEOENVIRONMENT 2: Salem Limestone, Indiana

Deposition of the Salem Limestone occurred 300 to 330 million years ago in a quiet, tropical sea that spread across an area that would become the Midwest. Like the Bahamas, where modern limestone is forming, the sea was warm, clear and shallow. The warm waters supported a diverse range of swimming, crawling and bottom-dwelling invertebrates. When they died, their bodies collected in a watery cemetery on the sea floor, eventually being covered by limy muds that precipitated from the sea water. The entire mass solidified into a 40-to-100-foot-thick limestone menagerie.

Crinoid stems, 3-10mm wide discs, are the next most common recognizable fossil. Crinoid were small invertebrates related to starfish, sand dollars and sea urchins. They resembled plants with a base attached to the substrate, a stem of varying length, and a flower-like top. The stems look like a stack of poker chips. Another important fossil is from a colonial animal known as a bryozoan. These sedentary animals formed communities that resembled a mass amalgamation of Rice Chex cereal. Only bits and pieces of their fragile homes remain. Careful investigation of the Salem Limestone reveals a hodgepodge of other miniature fossils, including half-inch-long snails, oysters, clams and scallops.

Quarrying began in the early 1800s. The Salem Limestone is one of the most commonly used building stones in the United States. Fossil-rich structures include the Empire State Building, Grand Central Station, Holocaust Memorial Museum, and San Francisco City Hall. In Seattle, the Seattle Times building, Rainier Club, and new Seattle Art Museum incorporate Salem building blocks.

Detailed information about this site is available at the following Web sites.

igs.indiana.edu/geology/structure/compendium/html/comp3mzo.cfm

www.indiana.edu/~librcsd/etext/hoosier/DS-04.html

Answers to questions asked of students on Paleoenvironment 2 handout

1. Do you think these sea creatures were fossilized? **Yes.**
2. If so, do you think the fossils are molds or did something else happen, such as permineralization? **Permineralization.**
3. Any guess what color the fossils might be? **White, usual color of calcium carbonate.**
4. Are they whole or broken? **Both, but mostly broken.**
5. Which were more likely to fossilize — shells or fish? **Mostly shells.**
6. Any guess what the species are in this drawing? **Corals, brachiopods, crinoids, snails, etc.**
7. If they did not fossilize, what happened? **Possible scenarios for non-fossilization or not being found. Wave action could have broken up the shells beyond recognition. A scavenger could have eaten the plant or animal. The chemistry in sea environment in which the plants and animals died could have been altered by an outside environmental event, which prevented fossilization. After fossilization, the rock unit that contained the fossils could have been eroded away or could still be buried so that a paleontologist couldn't find the fossil.**

PALEOENVIRONMENT 3: Fossil Buttes National Monument

Fifty million years ago, three large lakes covered Wyoming, Colorado, and Utah. The smallest, now called Fossil Lake, was 50 miles long and 20 miles wide at its maximum. Unlike modern Wyoming, the climate was subtropical with verdant forests of palms, figs and cypress. Willows, beeches, oaks, maples and ferns grew on the lower slopes of mountains that rose near the water. The warm lake waters supported 25 kinds of fish, insects, crocodiles and turtles, birds and dog-sized horses.

When the animals died, many settled to the bottom of the lake. Over time, a constant rain of calcium carbonate, which precipitated out of the water, dropped to the bottom of the lake and covered the fossils in layer after layer of fine grains. Although the lake once covered 1,000 square miles, the richest fossil beds only cover about 15 square miles. More may be buried, but that is all that are exposed.

The great 19th-century paleontologist Edward Drinker Cope was one of the first to excavate at Fossil Buttes. He worked there in the 1870s.

Additional information about this site is available at the following Web site.

nps.gov/fobu/expanded/fos.htm

Answers to questions asked of students on Paleoenvironment 3 handout

1. Did any of these species fossilize? **Yes.**
2. Did the volcanoes in the background play any role? **Yes, ash could have altered chemistry of water flowing into lake.**

3. What about the stream flowing into the lake? **Yes, altered chemistry of lake, which induced the calcium carbonate to precipitate out.**

4. Do you think it made a difference that the climate was warm? **Warm environment led to more evaporation of water and precipitation of calcium carbonate.**

5. How would this affect the lake?

6. If they did fossilize, do paleontologists find anything beside bones, such as skin or internal organs? **Mostly just bones.**

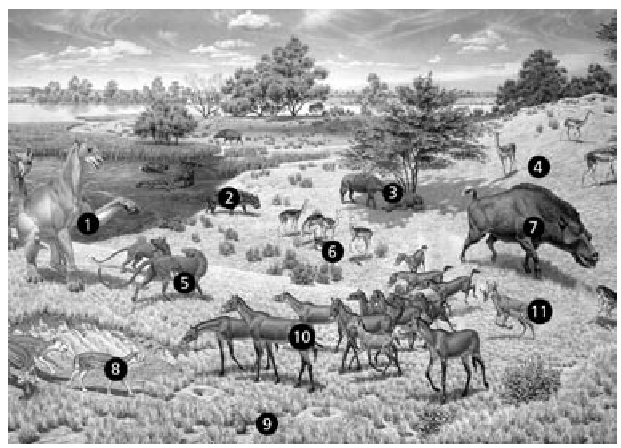
7. Do you think the fossils show good details or not? **Yes, quiet water at bottom of lake led to less decay and less breakup of bodies.**

8. Why wouldn't a plant or animal fossilize? **Wave action could have broken up the shells beyond recognition. A scavenger could have eaten the plant or animal. The chemistry in sea environment in which the plants and animals died could have been altered by an outside environmental event, which prevented fossilization. After fossilization, the rock unit that contained the fossils could have been eroded away or could still be buried so that a paleontologist couldn't find the fossil.**

PALEOENVIRONMENT 4: Agate Fossil Beds National Monument

About 21 million years ago, the plains of western Nebraska looked much like the modern-day Serengeti, with extensive grasslands dotted with trees through which great herds of grass- and leaf-eating animals wandered. Carnivores stalked the herds and small mammals burrowed in the rich soils. A wide river flowed through the area, creating watering holes and sand bars, but then a prolonged drought hit, killing hundreds to thousands of animals. When the rains returned, they filled the river beds and carried hundreds of bones to a backwater or lake. Over time the skeletons were buried under silt, fine sand and volcanic ash, carried by the wind and reworked by streams. A large fossilized waterhole with hundreds of skeletons is preserved today in the Niobrara River valley at Agate Fossil Beds National Monument.

The first excavations at the Agate Fossil Beds took place in the summer of 1904. Paleontologists from the Carnegie Museum at Pittsburgh discovered a rich quarry, containing a type of rhinoceros that was new to science. During a bigger dig in 1909, the Carnegie Museum removed at least 40 skeletons. The American Museum of Natural History began collecting the following year and continued for about 20 years.



Key to drawing (species names)

1. Moropus
2. Promerycochoerus
3. Menoceras
4. Oxydactylus
5. Daphaenodon
6. Stenomylus
7. Dinohyus
8. Merychyus
9. Palaeocastor
10. Parahippus
11. Syndyoceras

Detailed information about this site is available at the following Web sites.

www.npwrc.usgs.gov/resource/1998/agate/agate.htm

nps.gov/agfo/

The Dawn of Diversity

LIFE IN THE BURGESS SHALE

Answers to questions asked of students on Paleoenvironment 4 handout

1. Did all of these animals fossilize? **No.**

2. What about all of one type of animal? **No.**

3. Did climate make a difference in fossilization? **Yes, cycle of dry and wet key to preserving lots of animals. If climate had been consistent, probably would have gotten fossil formation but not such diversity or volume.**

4. Did size of animal make a difference in fossilization? **Yes, bigger skeletons would not travel as far and would be less susceptible to break up.**

5. How did they fossilize? **Permineralization.**

6. If they fossilized, were the fossils casts, molds or the bones themselves? **Bones.**

7. Do you think there were great accumulations of fossils or just a few bones here and there? **Great accumulations.**

PALEOENVIRONMENT 5: Petrified Forest National Park

About 225 million years ago, northeastern Arizona was located near the equator. A lush landscape with coniferous trees grew in a large basin with numerous rivers and streams flowing through the lowland. Volcanoes to the west spewed ash, which washed into the basin. When the trees died, rivers and streams carried the trees downstream. Many tree trunks came to rest on the river banks and others were buried in the stream channel. Some were buried by sediments before they could decompose. Ground water dissolved silica from the volcanic ash and carried it through the logs. This solution filled the cells and sometimes replaced the cell walls, a process called permineralization.

U.S. Army mappers found the petrified wood in the mid-1800s. Unfortunately, visitors soon started to remove vast quantities of the beautiful and interesting wood specimens. Naturalist John Muir, who spent time in the area, called for creation of a national park to protect the petrified wood and, in 1906, President Theodore Roosevelt made it into the 2nd National Monument.

Detailed information about this site is available at the following Web sites.

petrified.forest.national-park.com/info.htm#his

www.shannontech.com/ParkVision/PetForest/PetForest.html#parkhistory

Answers to questions asked of students on Paleoenvironment 5 handout

1. What was fossilized in this environment? **Plants and animals.**

2. Do you think there are great accumulations of the fossils or just a few plants here and there? **Great accumulations of plants, due to great quantities to begin with and due to rivers carrying remains to one spot, such as a river bend or onto a flood plain.**

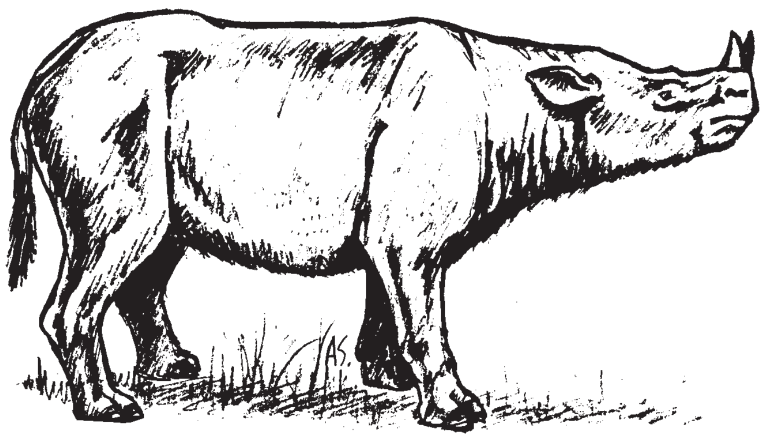
3. How did the fossils form? **Permineralization.**

4. Do you think the ash, which is made of silica (quartz) and could be dissolved by the water, was important to the fossilization process? **Very important. It provided the material in the ground water that replaced the tree cells.**

5. Do you think it is unusual for plants to be fossilized? **No.**

6. How else are plants fossilized? **Examples include settling in a lake bed, falling into amber, being covered by ash or lava to make molds and casts.**

Paleoenvironment 1



Rhinoceros near basalt flows — 15 million years ago
Drawing used courtesy of artist Arn Slettebak

For millions of years, lava erupted out of vents in eastern Washington. The lava flowed across the landscape at about 3 mph. Roughly 15 million years ago, a rhinoceros-like animal lived in this landscape of basaltic lava, lakes and trees. Pollen studies show that elm, alder, cypress, willow and cattails grew in the area. The climate was warm, temperate, and moist.

1. Could this rhinoceros have been fossilized?

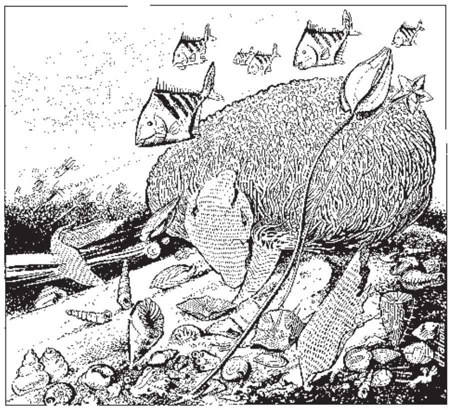
2. What clues do you get from the plants, such as the willows and cattails, that lived near the rhino?

3. If so, would it be likely to preserve the bones and teeth, or do you think only a mold would have been preserved?

4. If so, do you think that a rhinoceros preserved in basalt (hardened lava) is unusual in the fossil record?

5. If not, why wouldn't the rhinoceros have survived?

Paleoenvironment 2



Shallow Tropical Sea — 330 million years ago
From www.indiana.edu/~librcsd/etext/hoosier/DS-04.html

Between 300 and 330 million years ago, a quiet, tropical sea spread across an area that would become the Midwest. Like the Bahamas, where modern limestone is forming, the sea was warm, clear and shallow. The warm waters supported a diverse range of swimming, crawling and bottom-dwelling invertebrates.

1. Do you think these sea creatures were fossilized?

2. If so, do you think the fossils are molds or did something else happen, such as permineralization?

3. Any guess what color the fossils might be?

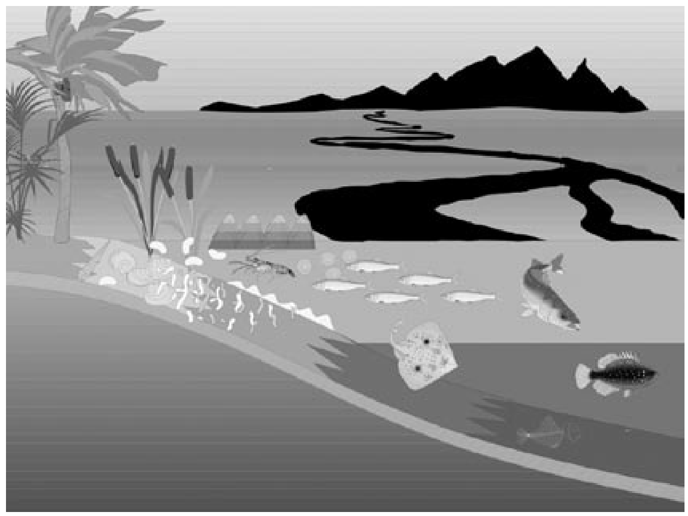
4. Are they whole or broken?

5. Which were more likely to fossilize — shells or fish?

6. Any guess what the species are in this drawing?

7. If they did not fossilize, what happened?

Paleoenvironment 3

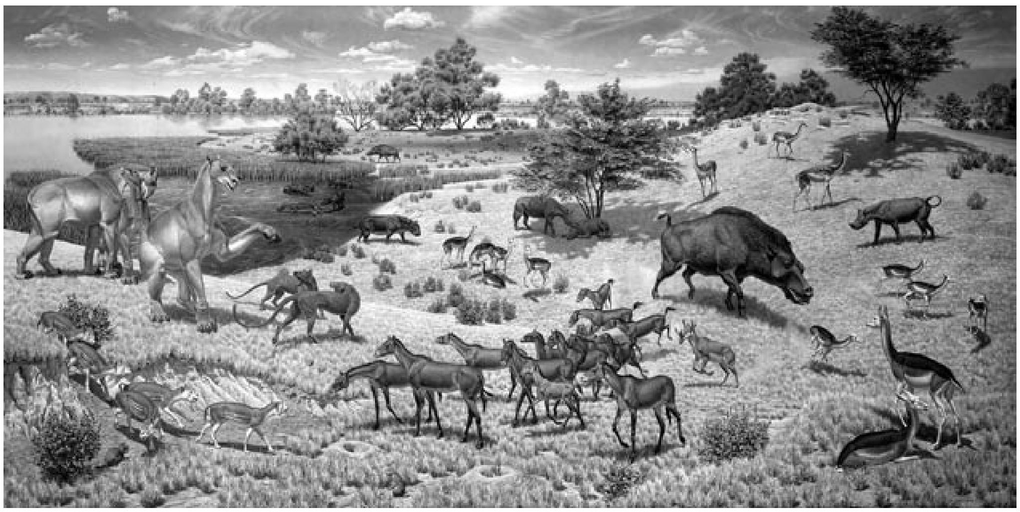


Shallow Lake — 50 million years ago
Drawing used courtesy Paul Buchheim

Fifty million years ago, Fossil Lake was 50 miles long and 20 miles wide at its maximum. It covered part of Wyoming, but unlike modern Wyoming the climate was subtropical with verdant forests of palms, figs and cypress. Willows, beeches, oaks, maples and ferns grew on the lower slopes of mountains that rose near the water. The warm lake waters supported 25 kinds of fish, insects, crocodiles and turtles, birds and dog-sized horses.

1. Did any of these species fossilize?
2. Did the volcanoes in the background play any role?
3. What about the stream flowing into the lake?
4. Do you think it made a difference that the climate was warm?
5. How would this affect the lake?
6. If they did fossilize, do paleontologists find anything beside bones, such as skin or internal organs?
7. Do you think the fossils show good details or not?
8. Why wouldn't a plant or animal fossilize?

Paleoenvironment 4



Savannah Teeming with Animals — 20 million years ago
Drawing courtesy of the Smithsonian Institution

About 21 million years ago the plains of western Nebraska looked much like the modern-day Serengeti, with extensive grasslands dotted with trees through which great herds of grass- and leaf-eating animals wandered. Carnivores stalked the herds and small mammals burrowed in the rich soils.

1. Did all of these animals fossilize?

2. What about all of one type of animal?

3. Did climate make a difference in fossilization?

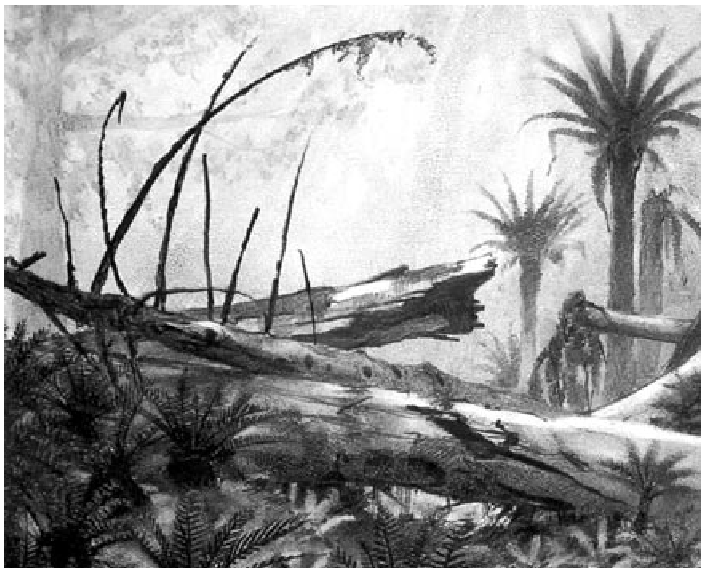
4. Did size of animal make a difference in fossilization?

5. How did they fossilize?

6. If they fossilized, were the fossils casts, molds or the bones themselves?

7. Do you think there were great accumulations of fossils or just a few bones here and there?

Paleoenvironment 5



Forest of trees — 225 million years ago
Drawing used courtesy of Petrified Forest Museum Association and artist Doug Henderson

About 225 million years ago, northeastern Arizona was located near the equator. A lush landscape with coniferous trees grew in a large basin with numerous rivers and streams flowing through the lowland. Volcanoes to the west spewed ash, which washed into the basin. When the trees died, rivers and streams carried the trees downstream. Many tree trunks came to rest on the river banks and others were buried in the stream channel.

1. What was fossilized in this environment?

2. Do you think there are great accumulations of the fossils or just a few plants here and there?

3. How did the fossils form?

4. Do you think the ash, which is made of silica (quartz) and could be dissolved by the water, was important to the fossilization process?

5. Do you think it is unusual for plants to be fossilized?

6. How else are plants fossilized?