"Eons and Eons of Ozarks Long Ago"

Directions: The table below describes various events in Missouri's geologic past that have lead to today's geologic conditions.

- Your team will read the table that your teacher assigns.
- Your team will then discuss the table and examine the sequence of events in the table. Afterwards your teacher will take the table away from you and provide you the table in cut up sections. Then your team will try to reconstruct the geological past by putting the table back together as best as you can.
- Once your team has completed the table reconstruction, ask the teacher for a key to check your work.
- After checking your table reconstruction, discuss where any mistakes have occurred. In a few cases the order may not significantly have any effect on the processes (and may not be a "mistake"). In the case of process the order is relevant and important.
- Your teacher may assign you to read and reconstruct other tables as time provides.

Radiometric Rock Ages
The further scientists go back in time the less they know, however they use many clues to reconstruct what may have occurred and use technology to take measurements of rock ages.
Scientists use sophisticated technology to make radiometric measurements of rock ages.
Geologists have evidence that the Earth formed 4.5 billion years ago. This age is determined by the radiometric dating of meteorites, a highly technical process involving the element uranium found in igneous rocks.
The time that it takes one half of a radioactive element to decay or turn into a stable non-radioactive element is called a half-life.
The oldest rocks on Earth have been dated using radiometric dating to be nearly 4 billion years old. Scientists assumes that the Earth and solar system formed at the same time.
The first 88 percent of the Earth's history is called the Precambrian Era. During this era there are indications of simple forms of animal and plant life and algae.
The base of the Ozarks was formed at least 1.4 billion of years ago when outpouring of lava from volcanoes and vents occurred.
Igneous rocks in the St. Francois Mountain have been radiometric dated to 1.4 billion years old.

Fossils Form in Warm Shallow Seas
During most of Missouri's geological past, the state has been covered by warm shallow seas. *[North American was located at lower latitude and had not moved on the north American plate to its present temperate location.]*
These warm shallow seas of eons ago were teeming with life. These marine organisms were diverse.
Many of these marine organisms had shells made of the mineral calcite (consisting of the elements calcium, carbon, and oxygen).
After the shelled organisms died, gravity pulled them down to the bottom of the sea. Many of them became dissolved into calcite particles. Some organisms remained all or partly intact.
These layers of sediments formed in horizontal layers. Geologists call this the principle of horizontality.
Many shelled organisms fell into soft sediments. When they hit these soft weak sediments, many made an impression in the sea bottom.
After time, the soft tissue of the organism decayed away and the "hard parts" or shells remained making a "mold" of the organism, forming fossils.
Some of these molds later were filled with dissolved minerals in the water and in time became "casts" of the organism. These hard parts were buried in the continuous layers of sediments. Eventually, other shelled organisms died and fell to the sea floor.
In time these sediments were cemented together by calcite and harden into the sedimentary rock limestone, often containing marine fossils.
Dolomite formed later in some cases when magnesium replaced calcium ions in the molecules.
Today these rock layers can be seen on bluffs along Missouri streams, and along road cuts on highways. These are good places to hunt for fossils.
Geologists infer that if these sedimentary rocks layers are not disturbed (folded or faulted), the older rocks are on the bottom and the youngest are on top. This is called "relative" dating.

Missouri Marine and Land Fossils

Most of Missouri fossils are marine organisms. They lived in the state eons ago when it was covered with warm shallow seas. Later in geological history, fossil evidence shows that ferns and even giant ancestors of elephants lived in Missouri.

One of the oldest of the Missouri fossils is the "trilobite." It lived in a variety of habitats from swimming in open water to crawling along the sea bottom and burrowing in the soft sea floor. Most ranged in size from 1 to 3 inches. They had three "lobes." This is why they are called the "tri – lobite."

Other marine life includes bivalves or brachiopods that had two shells somewhat like a clam; however they were very different in their internal structure. The animal would open its shell to feed on microscopic animal life and get oxygen.

Besides bivalves, the shallow oceans also were home to gastropods, which are animals whose bodies consisted of a long tapering tube, tightly coiled in a spiral shape, somewhat like a snail. They lived in the sea, in fresh water, and on moist land areas, much like the snails of today.

Like the gastropods and bivalves, crinoids are animals that lived in great colonies of thousands of individuals on the sea bottom. Intact crinoids look like a plant with a long stem and a "flower" on top that is actually "arms."

Brachiopods and crinoids both have descendants that are abundant in the warm shallow seas of today.

Other Missouri marine animal fossils include bryozoans (sponges) corals and blastoids (bud-like creatures).

More than shelled organisms lived in this shallow sea; fish that lived millions of years ago can also be found as imprints in sedimentary rocks.

Missouri land fossils include land plant imprints such as ferns (found in coal beds) from the Missouri swamps of eons ago.

Other land fossils include mastodon bones. These large hairy elephant-like mammals lived during the ice age long after the warm shallow seas had evaporated and North America had moved to its present location.

Mastodon bones are now on display at Mastodon State Park south of St. Louis.

With diligent hunting, Missouri's marine fossils can be found in molds and casts in Missouri's sedimentary rocks along bluffs and road cuts.

Ozark Dome Formation
Molten rock beneath the Earth's surface formed gigantic plutons that pushed the first Ozark land surface above the waters of the ancient ocean.
Small island chains know as the St. Francois Islands formed in this sea.
The sedimentary rocks that were created in the warm shallow seas of eons and eons ago were pushed to the surface.
As time passed ancient seas' coastlines changed and the Missouri of long ago went through periods of seas covering and uncovering Missouri's territory.
The Ozarks have been continuously out of the sea for a very long time. During this time, rain has eroded the land's surface, eating though many layers of sedimentary rock from the former sea. Much of the fossil evidence has been destroyed, and only the older layers remain today.

Formation of Karst Features
Long after the shallow seas were gone and limestone and dolomite rocks covered the Ozarks, the water cycle powered by the sun provided rain water that soaked into the ground.
The rainwater picked up carbon dioxide from decaying plant matter as it soaked into the ground.
The groundwater became a weak carbonic acid and soaked into fractures or cracks in the limestone and dolomite rocks.
Slowly over time this weak carbonic acid dissolved the rocks along the fractures.
Over time the fractures became larger and larger, creating the cave systems of today.
As groundwater levels dropped, these cavities drained. Some caves were then filled with air. In those caves, “decorations” developed. These are features which form from calcite, which is deposited out of groundwater that drips into the caves from above.
A sinkhole forms when a cave roof collapses. Sinkholes allow surface water to quickly enter the groundwater system.
Some streams in the Ozarks won’t hold water and are called losing streams. They form when the ground underneath the stream has many openings, caused by weak carbonic acid dissolving the rocks below. These openings allow surface water to go directly down into the groundwater system.
Groundwater sometimes finds an opening in a hillside or valley, then it comes out onto the surface to form a spring. Many big springs are in the Ozarks.
Dissolved calcium from the limestone and dolomite rocks can be found in Ozark groundwater, which area residents of today depend on to drink.