Marengo Cave Teacher Resources Grades 1-12

Marengo Cave was discovered on September 6, 1883 by two children, Blanch and Orris Heistand. With the help of our teacher resources and student activities Marengo Cave can be re-discovered by the students in your classroom.

If you have only this document, and do not have the reference visuals or student activities you may download them online (see below).

We only hope that you and your students will have as much fun learning about caves as we've had preparing these materials.

Thank you for your interest in Marengo Cave!

Teacher Resources Online
http://www.marengocave.com/teachers

What is a Cave?

A cave is a natural underground cavity or hole. Such cavities are usually classed as caves, only if they are large enough to permit entry by humans. A large cave or system of caves is often called a cavern. Caves can be found in the sides of cliffs, under hills, mountains, and sometimes even under flatland.

A mine is not a cave, since mines are manmade. Natural processes such as wind, waves, lava flow, water or ice form caves.

Different Types of Caves

The various types of caves most often get their names from how they were formed. Limestone caves are the most common type and the best known. Limestone caves are solution caves, formed by a mild aid literally dissolving the rock. Marengo Cave is a solution cave in limestone, as is Mammoth Cave, in Kentucky. Approximately ninety-five percent of the world's caves are found in limestone.

Most limestone caves are formed when carbonic acid dissolves the rock through a very slow process. This process begins with rain, which absorbs a small amount of carbon dioxide as it falls through the atmosphere. Rain gathers additional carbon dioxide as it moves down through the soil, where carbon dioxide comes from decaying plants. Rainwater mixed with carbon dioxide forms a weak solution of carbonic acid. As the acid seeps into the cracks and crevices in the soluble limestone, it begins to form cavities and channels.

Sea caves are formed by wave action. The waves force water into the cracks in the rock. The water, wind and sand are powerful grinding agents that cut away at the rock face until it forms a cave. The stone might be of any material. The hardest granite, or the softest chalk can be cut away because the action is abrasion, not the dissolving of rock. The Pacific coast of the USA has a large number of sea caves.

Sandstone or wind caves are almost always small caves that seldom penetrate into total darkness. They are formed by wind erosion of cliffs or hills. Sandstone, one of the most common sedimentary rocks, is easily eroded by weather and wind. The face of a sandstone cliff is often pitted with shallow holes and pockets. Sometimes, however, they tunnel completely through a wall to form the natural arches and bridges that are common in the western United States.

Shallow sandstone caves were valuable to the Native Americans and early settlers for protection from the weather and enemy attack.

Lava tubes or lava caves are formed in volcanic lava flows, by the cooling of molten rock. To begin, a crust forms on the lava as it starts to cool. Since the core is still hot and liquid, the center continues to flow out the end of this crudely formed tube. In a short time, the molten lava drains out, the entire flow cools, and the lava tube or cave is formed.

Ice caves are natural caves found at high elevations and in regions where the average annual temperature is at or below freezing. Often they contain ice formations rather than calcite formations.

Glacier caves are formed by carrying off melting waters that develop tunnels in the glacier ice. Many such caves are found in Alaska, on Mt. Ranier in Washington State, and in Canada.

Earthquake caves are deep, generally vertical cracks in the earth's crust caused by earthquakes. In some cases, explorers have been able to descend 500 feet below the surface in such caves. Seneca Cavern in Ohio is an earthquake cave that is open to the public.

Soil tubes are found in desert areas, where they are formed by flash floods. Caves of this type are found in the Mohave Desert.

Hugh rock falls from cliff areas forms talus caves. The rock and debris pile up at the bottom of the cliff, leaving covered rooms and passages between the rocks.

Speleology, the study of caves, centers on four types of caves: limestone, sandstone, sea caves, and lava tubes. Of the eight types of caves described, limestone caves constitute over 95 percent of the caves knows in the world.

Caves can be divided into categories in ways other than origin process. Most caves are "wild caves", that is they are undeveloped, and should be entered only by experienced cave explorers. The natural cave environment, so unlike the world we know, can be experienced in such caves.

A relatively small number of caves are protected as "show caves", open to the public and either publicly or privately owned. There are generally an admission fee, walkways are readily accessible, and speleothems are lighted to highlight nature's handiwork.

How is Limestone Formed?

Limestone is a sedimentary rock that formed in layers at the bottom of an ancient sea. Over vast spans of time, deposits of marine life in the form of shells, skeletons, and coral accumulated on the ocean floor. These layered deposits accumulated to great depths and were compressed into limestone by the weight and pressure of the water and the sediments above. Later, as the sea receded, forces lifted the area. As the layers of rock were exposed to the air and rain, the process of forming limestone caves began.

Four conditions are necessary to form a limestone cave like Marengo Cave, and all must be present at the same time. First, adequate rainfall must provide water. Second, cracks or fractures must be present for water to flow through. In addition, the rock must be soluble, and the water must be able to drain.

Precipitation in the form of rain or snow, combined with atmospheric carbon dioxide forms weak carbonic acid, which is further acidified as it comes through the organic soil above the bedrock. Moving along joints in the bedrock, this acidic ground water dissolves the limestone and continues downward in the water table. It appears that most limestone is dissolved at or near the water table, forming caves. When the water table drops, cave passages are no longer water filled. Lower passages may be enlarged by an active, flowing stream in an air filled passage. Marengo Cave shows much of this type of cave development.

When ventilation of the cave begins, this change marks the beginning of a reverse process, the deposition of calcite in the form of stalactites and other speleothems.

Chemically, caves are formed when carbon dioxide combines with water to produce carbonic acid, which in turn dissolves calcite/limestone.

$CO_2 + H_2O \rightarrow H_2CO_2$	Carbon dioxide mixes with water to form carbonic acid
$H_2CO_2 + CaCO_3 \rightarrow Ca_s + 2HCO_3$	Carbonic acid dissolves calcite from the limestone producing a calcium bicarbonate solution.

How are Speleothems Formed?

Geologists refer to cave formations such as stalactites and stalagmites as speleothems, which comes from the Greek words "spelaion" (cave) and "thema" (deposit).

Speleothems are primarily made up of calcite, the same mineral that limestone is made of. Like the development of the cave itself, the story begins with rainwater. Rainwater passing through the soil combines with carbon dioxide to produce carbonic acid. Calcite is dissolved from the limestone rock above the cave by the acidic water seeping downward.

When the mineral laden water reaches the air filled passages of a cave, a chemical action takes place and the calcite is deposited by the loss of carbon dioxide from the dripping water. The water can no longer hold the calcite in solution when the carbon dioxide gas leaves the water. This occurs for the same reason that carbon dioxide leaves an open bottle or can of carbonated soft drink. This process is the reverse of that process by which limestone is dissolved to form caves.

The calcite is not deposited by evaporation of water; in the near 100 percent humidity of most caves, evaporation is impossible. The loss of carbon dioxide is responsible for calcite speleothem development.

$$Ca^{2+} + 2HCO_3^{1-} \rightarrow CO_2^{\uparrow} + CaCO_3 + H_2O$$

Once inside the cave the carbon dioxide is released from the calcium carbonate, leaving only water and calcite behind.

Speleothems of Marengo Cave

The word speleothem is a geologic term referring to any or all of the mineral deposits or formations found in caves. Most cave formations are crystalline deposits of calcium carbonate or calcite.

The following is a list of the most common cave speleothems and a description of how each is formed:

- Soda straws are thin walled, hollow tubes approximately one-quarter inch in diameter. Each begins as a drop of water saturated with calcium carbonate that leaves a tiny deposit of calcite as it drops from the ceiling. First a tiny ring the size of the drop is formed; then ring upon ring until the hollow, straw-like tube extends form the ceiling.

- Stalactites grow down from the ceiling (note the "c" for ceiling), forming as mineral laden water runs down the outside of a soda straw. This happens when the hollow soda straw becomes plugged. If it is a slow drip, the calcite has time to be deposited on the ceiling, forming the distinctive "carrot" shape. Many beautiful stalactites of diverse size, color, and shape decorate the passages on the Crystal Palace Tour.

- Stalagmites grow up from the floor (note "g" for ground), when mineral laden waters drip from above. A stalagmite is usually rounder than stalactites, has a blunt tip, and no central tube. Their location is entirely dependent on dripping water. Cave Hill Cemetery has a high proportion of stalagmites.

- Columns or pillars form when a stalactite and stalagmite join to form a solid pillar of stone reaching from the floor to ceiling. Columns may also from when either a stalactite or stalagmite grows from floor to ceiling, or vice versa.

- Cave Coral are knobby clusters that look like (and sometimes are referred to as) popcorn. Cave coral or popcorn can form in the highly saturated atmosphere of the cave under special conditions.

- Draperies from when mineral laden water trickles down the underside of a slopping ceiling or ledge, leaving the deposits in sinuous trails. As each drop follows the preceding drop downward, the water deposits calcite and builds a thin, translucent sheet the width of the drop. When a light is shown through a drapery, their colored bands give the appearance of fried bacon. The Indian Blanket in Crystal Palace is a spectacular example of drapery.

- Flowstone forms where films of water flow over walls, floors, and other formations. Sheets of calcite are deposited in successive layers. Flowstone often resembles a frozen waterfall.

- Rim stone dams are step-like terraces on cave floors that enclose pools of water behind them. The calcite is deposited when the water loses its carbon dioxide as it flows over the edge of the dam.

How are Caves Used?

Caves have been used in many ways in the past and new uses continue to be developed. Throughout the world, caves have been used as shelters and dwellings. Beautiful drawings of animals and hunters have been preserved thousands of years in European caves, which were occupied long ago. Large numbers of people continue to live in caves in China and other locations.

Caves have also been used as burial sites, storehouses, places of worship as well as entertainment sites, and sources of raw materials. Native American people mined high quality flint from nearby Wyandotte Cave. Later, saltpeter was mined for the production of gunpowder for both the Revolutionary War and the Civil War. Bat guano has been mined for fertilizer. Caves have also been used as wine cellars, mushroom production, and even sources of "air conditioning". Today, caves serve as natural laboratories for geologists and biologists and have been researched for potential medicinal compounds.

Caves have been shown commercially for nearly 200 years in the United States. Such "show caves" offer the opportunity to visit the special world of caves in a safe and informative way. Such caves are better protected from vandalism and environmental change than most undeveloped caves.

Wild cave exploring as a hobby is a relatively new sport. Whether cave exploring is dangerous or not depends on the caver. There are basic rules, which must be followed including: never enter a cave alone, carry at least three sources of light, and always let someone know where you're going. Cave explorers always need to obtain permission from the landowner before entering a cave. Most important, always leave the cave as you found it!

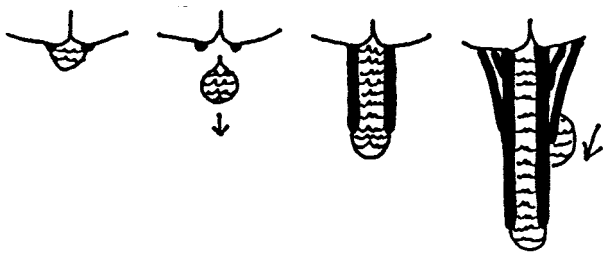
For those interested in learning more about caves and cave exploring, the National Speleological Society offers information and local organizations (called grottoes) in many cities. For more information you can visit them at their website, www.nss.com.

Surface Relationships of Caves

Caves and the land under which they are located are closely tied together. What happens on the surface greatly affects the cave below. Groundwater pollution in the karst area of southern Indiana and Kentucky is a serious problem. Unfortunately, many people almost expect surface streams to be polluted by runoff, but yet believe that underground water is pure and clean.

Underground waters are polluted by many sources including industrial pollution carried into caves by rainwater's and agricultural pollution including animal wastes, fertilizer and pesticides. Landfills and sewage systems, or the lack thereof, also pollute caves and underground streams. Such subsurface pollution can dramatically alter the delicate balance of nature found in the cave.

Helictites or heligmites are small, twisted formations that project from ceilings and walls of caves at many angles, and seem to defy gravity. Each helictite begins as a tiny stalactite, then for some reason the chemical content of the water changes slightly. Such impurities cause the single crystal structure to change form a cylindrical, prismatic shape to a slightly conical one. Each subsequent cone fits onto the previous one like a stack of inverted ice-cream cones. This shape is unstable, allowing the direction of crystal growth to vary from vertical. The formation still has a tube that allows water to flow through, irregardless of the direction the tube takes. The result can be very unusual twisting, curious speleothems. Marengo Cave has helictites near the "Elephants Head," on the Dripstone Tour.



A stalactite begins growing as a small ring of calcite where the surface of the water drop intersects the ceiling of a cave. This ring grows into a tube (or soda straw), which often acquires a tapering shape when the water flows down its outer surface.

Cave Life

Very special plants and animals live in a cave, where there is little change. This lack of change is found only in caves and in the depths of the ocean. Plants and animals that live in a cave environment must be able to adapt to the unique conditions of a typical cave: total darkness, constant temperature, and high humidity.

Plant Life

Only non-green plants live in the total darkness of a cave, they depend on decay rather than photosynthesis for food. Bacteria and fungi are the only natural plants that live in caves, and they play a vital role in the cave food chain.

Animal Life in a Cave

Animals that live in the cave can be classified by the proportion of their lifespan spent in the cave and whether they could live outside the cave. Animals that spend their entire life in the cave feature special adaptations.

The three basic types of animal life found in the cave are:

Trogloxenes - from the Greek words troglos (cave) and xenos (guest),
Troglophiles - from the Greek words troglos (cave) and phileo (love), and
Troglobites - from the Greek words troglos (cave) and bios (life).

Trogloxenes are temporary cave residents, which can freely move in and out of the cave. Trogloxenes can include bears, bats, moths skunks, raccoons, and of course, humans. They usually stay near the entrance.

Troglophiles regularly live in the dark zones of the cave, although, they can and do survive outside the cave. Cave beetles, cave crickets, salamanders and crustaceans can live as troglophiles.

Troglobites live exclusively in caves, in total darkness. They often have reduced amounts of pigment, and can even be pure white. Many have very small eyes or none at all. Examples include blindfish, cave shrimp, millipedes, isopods, and many insects.

Cave animals generally stay in a specific zone such as the entrance, twilight, or dark zone. Within a zone, animals usually live in a specific area - the ceiling, floor or walls. In cave water you can find: flatworms, amphipods, isopods, fish and crayfish. In or near mud: worms, beetles, millipedes, and springtails are found. On walls, centipedes, salamanders and harvestmen ("daddy long legs") are found. Mosquitoes, flies, spiders, crickets and bats prefer ceilings.

Marengo Cave contains many types of animal life. In fact, the cave is the "type locality" of five cave organisms, which means they were first discovered there. Blind cave fish are found in the lower stream level of the cave, but not in the section of the cave that is toured. Blind cave crayfish are common, but rarely seen. Marengo's bat population is small, but it is not unusual to see a bat flying in the cave.

The Cave Food Chain

Detritus, which includes leaves, twigs, animal manure, and dead plants and animals, forms the basis of the cave food chain. Much of this material is brought into the cave by water from the surface and in flooding cave streams. Fungi are carried into the cave by air currents, in water or on the bodies of animal. They obtain nourishment by breaking down the detritus in the cave. Insects such as beetles and mites then feed on these molds and bacteria. The beetles, other insects and small aquatic animals in turn serve as food for larger cave predators. Organic material is returned to the cave environment from the dead bodies and droppings of these larger animals.

The balance of nature in the cave food chain is very fragile, as are the species found underground. Those who visit any cave must be careful not to upset this delicate balance. The motto of cave explorers is:

"Take nothing but pictures,
Leave nothing but footprints,
Kill nothing but time."

This should be the goal of all cave visitors; we hope you will make it yours.

Additional sources of information

National Speleological Society
Cave Avenue
Huntsville, AL 35810

Bat Conservation International
Box 162603
Austin, TX. 78716-26-0

American Cave Conservation Association
Box 409
Horse Cave, KY 42749

Marengo Cave Vocabulary List

Breakdown – materials that have fallen from the ceilings and walls of caves.

Calcite – a common mineral composed of calcium carbonate ($CaCO_3$), which is the main constituent of limestone.

Carbonic Acid – acid formed when carbon dioxide combines with water.

Cave – hollow chamber in rock, formed naturally.

Caving – the sport of cave exploring. Synonymous with spelunking.

Ground water – underground water within the zone of saturation.

Karsts – a limestone region marked by sinkholes and caverns. Usually there are no surface streams, and the limestone has been exposed by erosion.

Limestone – a sedimentary rock composed primarily of calcium carbonate.

Show caves – privately or publicly owned caves open to the public. Over 175 are privately owned in the United States.

Speleology – the study of caves.

Speleothem – geologic term used for any mineral deposit found in caves such as stalagmites, stalactites, etc.

Trogolobite – an animal that cannot survive outside the cave environment, completes lifecycle in a cave.

Troglophile – an animal that can complete its lifecycle either in a cave or on the surface.

Trogloxene – an animal that habitually lives in or visits caves, but must return to the surface to complete its lifecycle.

Water table – surface underground below which all rock is saturated with water. It is an irregular surface with slope and shape determined by hydrostatic pressure.