



Museum of Natural History & Science Interpretation Guide for *The Cavern*

A cave is a naturally occurring hole in the ground large enough to be explored by humans. Caves can be found on every continent in the world. Caves, along with the objects found within them, are extremely fragile and take millions of years to form. They are home to unique organisms—many of which are still unknown to science; they are archaeological sites that preserve our cultural heritage; and geologic laboratories that demonstrate how water can both dissolve and deposit rock. Caves are a vital and non-renewable resource that must be conserved and protected.

The Cavern is a recreation of a Kentucky limestone dissolution cave. It is the largest artificial cave in the United States—and some say the world—containing 535 feet of passage in an area 44 feet wide, 24 feet high and 64 feet long. Parts of the cave were modeled after two caves in Kentucky: Teamers Cave in Rockcastle County and Dyches Bridge Cave in Pulaski County. By modeling our cavern after these two caves, our dissolution cave has a realistic appearance.

A dissolution cave is by far the most common type of cave. They can be found throughout the world if the right conditions present themselves. The formation of a dissolution cave requires four basic elements: rock, water, carbon dioxide and time.

- **Rock**, especially carbonate rocks, such as limestone, is the first ingredient. These types of rocks were formed hundreds of millions of years ago. It is in the seas surrounding the continents that limestone is formed. When sea animals, such as brachiopods and crinoids, died, their soft parts disintegrated and their hard parts, such as their shells, fell to the bottom and accumulated over time. With the addition of heat and pressure, coming from more material lying over top, the animal remains were changed into rock. These rocks were laid down in layers called beds. Between these beds are bedding planes. Also, due to the shifting of rock joints or fissures are formed. It is along these bedding planes, joints and fissures that the rock is dissolved to form dissolution caves.
- **Water** is the second ingredient. It comes primarily from precipitation—rain and snow. When water is modified by carbon dioxide it dissolves the carbonate rock.
- **Carbon dioxide** is created in the soil by decaying plant and animal matter. When the carbon dioxide mixes with the water it forms a weak acid called carbonic acid. Incidentally, it is the same acid that is found in carbonated beverages, though in soft drinks it is 50 times stronger than in caves.
- **Time** is the last component. Dependent upon specific conditions at the cave's location, the time needed to form a cave varies. Tropical areas, which have heavy rains and a lot of decaying plant and animal matter form caves faster than areas close to the poles. But regardless of location, it still takes millions of years to form a cave. The time needed in cave formation is just reason why caves should be protected.

Now that you understand the elements behind cave formation, it's time to discuss how these ingredients come together to physically create a cave. Water falls through the air as rain or snow and travels down through the soil where it picks up carbon dioxide from decaying plant and animal matter. When the carbon dioxide and water mix, they form carbonic acid. The acidic water enters slowly through a crack or input point in the rock and widens it by dissolving the surrounding rock. It then exits through an output point in the form of a spring, waterfall, or a small drip on a ceiling or wall. This process, continuing over millions of years, will form a dissolution cave.

With the creation of a cave, other cave structures, referred to as speleothems, are also formed. There are three types of speleothems: dripstone or flowstone form, erratic form and sub-aqueous form. Together, these three types of speleothems turn the caves into geologic works of art.

- **Dripstone or flowstone** formations are speleothems that have gravity-controlled growth. This group contains the most well known types of speleothems. They are usually formed from calcium carbonate (CaCO_3). There are four main dripstone/flowstone speleothems:
 1. **Stalactites** – these structures are formed when water moving through the limestone dissolves away some of the rock. When that water reaches a passage of the cave, it forms a drop on the ceiling. As the drop hangs there, some of the carbon dioxide dissolves out into the air and the drop becomes supersaturated with calcite from the rock. The small area where the drop was last attached is where some of the calcite is left behind. Over time, this material will form a speleothem called a *soda straw*. As the soda straw continues to grow, water may be forced to move along its outer surface rather than along the hollow center. When this happens, the formation becomes less straw-like and more cone-like. The soda straw has now become a stalactite.
 2. **Stalagmites** – these structures are formed when water droplets falling from the ceiling hit the ground. This causes more carbon dioxide to be driven off and the rest of the mineral matter dissolved from the rock builds up on the floor, thus forming a stalagmite. *An easy way to remember stalactites versus stalagmites is in the saying: Stalactites, hang on tight; Stalagmites, grow up might.*
 3. **Draperies** – these structures are formed when water drops flow down an inclined ceiling, leaving behind a trail of calcium carbonate. Through time, more drops continue along this trail, depositing layers and creating the shape of a drapery. These speleothems are translucent, so you could shine a light right through them.
 4. **Flowstone Sheets** – these structures are formed as water flows down a wall depositing sheets of calcium carbonate. The calcium carbonate crystals are deposited perpendicular to the surface and can be large on the outer surface.
- **Erratic speleothems** are crystal growth controlled speleothems. The types of erratic speleothems found within *the Cavern* include:
 1. **Helictites** – these formations look like twisted soda straws. They are formed by slow, seeping water that is moving too slowly to form drops. As the water seeps out, it deposits calcite at different angles, which is what gives helictites their 'twisted' shape.
 2. **Gypsum speleothems** – these structures are found only in the drier parts of a cavern. Like helictites, they are also formed by slow, seeping water. In gypsum formations the mineral being deposited is calcium sulfate. Gypsum flowers are found on the walls of many drier caves. They grow from their bases instead of their tips, like many other speleothems. Each petal of the flower is pushed outward, sometimes a foot or more, as new crystals form at the bottom.
 3. **Gypsum needles** – these structures grow like fragile strands of glass from the sediment of cave floors. These speleothems will eventually break as a result of their own weight. Often these delicate needles are found lying in jumbled heaps.
 4. **Gypsum crust** – these structures are formed by the weathering of iron sulfide in the limestone. The crust can be white or golden brown. The gypsum crust can grow to half an inch thick on the walls of some caves.

- **Sub-aqueous speleothems** are formed—as the name implies—under water. Within *the Cave* there are two sub-aqueous speleothems:
 1. **Pool deposits** – these are formed when standing water in small pools continues to lose carbon dioxide. The water then becomes supersaturated with calcite, which begins to be deposited in the pools.
 2. **Rimstone dams** – these are formed when pool deposits dam themselves by depositing calcite on the margins of the pool. During this action, carbon dioxide is driven off as the water flows over the dam. Together, these actions form rimstone dams, which are normally thinner than they are high and often have a complex winding pattern.

With the basics of cave geology now explained, it is time to venture into *the Cave*. Within *the Cavern* we have two unique trails. The Beginner Trail is wheelchair and stroller accessible. This is a great trail to start your caving adventure and will take about five minutes to walk through. The Beginner Trail also offers overlooks into the Advanced Trail. The Advanced Trail is more like a real cave experience. This trail has closer confines, a waterfall, bat chamber, and stairs that take you up and down 20 feet. This trail will take about 10 minutes to explore. Both of these trails exit just to the left of *the Cavern* entrance.

Beginner Trail

Entering *the Cavern*, you will be in the first zone of the cave, referred to as the twilight zone. This zone begins at the cave entrance and is where light permits human sight. Animals that live within this zone are referred to as troglonexes or cave guests. An example of a troglonex greets you just beyond the entrance—the packrat. Packrats build nests in caves using twigs and leaves. They have large eyes and long whiskers to find their way in the darkened cave. Packrats have a unique way of not losing their way—they leave behind a trail of urine to the entrance. Packrats must leave the cave in search of food such as grain, seeds, fruits, leaves and roots. Aside from packrats, humans have also inhabited caves for shelter. Many cave sites have been discovered containing human artifact remains or cave art, examples of which are displayed on the ramp heading toward the cave.

Continuing along the trail, one enters the variable-temperate zone of the cave and stumbles across a spelunker. A spelunker is a person who explores cave. Take note to look at all of the gear this spelunker is carrying with him on his cave adventure. A spelunker never knows what they might run into in a cave. Sometimes there are tight chambers to crawl through, low ceilings to duck below and always there is darkness. In fact, the cave is so dark that if you were to hold your hand up in front of your face you could not see it. Remember, when exploring caves it is best to go prepared, go with a partner and to inform someone of your destination.

Leaving the spelunker behind us, we enter our formation room in the third zone of the cave referred to as the deep cave zone. In this room you can see examples of speleothems including stalactites, stalagmites and soda straws. Looking in the cases on the wall you can also see gypsum speleothems such as gypsum needles, snowballs and helictites. Taking your attention away from the speleothems you come face to face with cave crickets and cave beetles. There are many differences in the cave cricket and cave beetle as compared to the non-cave species that we have locally. The cave cricket has extended antennae, which are constantly in motion to detect odors and to sense air molecules. The cave beetle has elongated appendages as well as a more powerful jaw. Cave beetles are actually blind, as they have no optic nerves to send signals of sight to their brains. It is important to note that cave crickets are troglonexes, meaning that they are cave guests. Although they have adapted by growing longer antennae, one third of the population of cave crickets must leave the cave each night in order to find food. On the other hand, cave beetles have adapted to life within the cave and are considered to be troglobites, which are cave dwellers

who have adapted to the harsh life of the cave. The third type of cave creature is referred to as a troglophile, which means cave lover. Animals within this category are earthworms and salamanders, as they prefer moist, dark areas. These preferences could lead to life in a cave or under a rock.

Before leaving the formation room, make sure to stop at the jaguar skeleton. The jaguar is what is referred to as an accidental. An accidental is an animal that has entered into the cave, but because of the absolute darkness, does not have the skills needed to survive in such a harsh environment. Having no skills to survive in absolute darkness—unable to find food and water—and having lost its way, the jaguar died in the cave. Having enough light in our cave for human sight, find your way to the exit and loop around to explore the Advanced Trail if the spelunker in you is wanting more.

Advanced Trail

Entering the cave you will descend down the stairs, passing a mural illustrating that you are in the twilight zone, or entrance, of the cave. Animals that live in this zone are referred to as troglaxenes, or cave guests. One example is the raccoon that you can see entering the cave. Many animals like to stay in caves because the temperature is typically around 55° F, making it cool in the summer and warm in the winter. Aside from raccoons, humans have also inhabited caves for shelter. Many cave sites have been discovered containing human artifact remains or cave art, examples of which are displayed on the ramp heading toward the cave. Also, within the mural's landscape there are sinkholes, often the indicators for what is termed karst topography.

Delving further into the cave, notice another troglaxene—the packrat. Packrats build nests in caves using twigs and leaves. They usually live at cave entrances where the light is dim. Packrats leave behind a trail of urine so it can find its way back to the entrance by using its sense of smell. Rounding the bend in the trail, more troglaxenes can be found—Big Brown Bats. Within our colony of 11 bats you can observe bat behavior. Remember to keep your voices down, as they are nocturnal animals.

Winding through a narrow trail, notice the different fossils along the walls of limestone. The fossils that you are seeing are all animals of the sea, stemming from the formation of limestone and other carbonate rocks. On the ledge at the bend are crinoids and crinoid rings. For further fossil exploration, all of these fossils can be found in *Nature's Trading Post*. Stopping at the exhibit cases, one can also experience cave crickets, cave beetles, gypsum needles, gypsum flowers, snowflakes and helictites.

Continuing through the passage, it opens into a chamber. Be careful of your footing as the floors are often moist and could be slippery! Standing in the chamber, you will immediately notice the waterfall. Look closely to see that the waterfall has carved indentations in the wall indicating the previous route of the waterfall. Behind you, against the far wall, you will see a pile of stone. If you look up, you can see that this is partial cave-in—a portion of the wall above has fallen in. Having investigated the chamber, cross over the rock bridge and continue your cave exploration.

Continuing on the trail you will enter into another large chamber—the formation room. In this chamber you will see many different speleothems including stalactites, stalagmites, columns, soda straws, draperies, flowstone sheets and rimstone dams. After examining the formations, take time to try your hand at spelunking as you attempt to crawl, shimmy and squeeze through narrow passages.

Leaving the formation chamber you will rise to the height of the cave and have a great lookout to the formations below. Continuing on the trail you will pass a jaguar skeleton, an example of an

accidental, or an animal that has gotten lost in the cave and was unable to survive in absolute darkness.

Descending down the stairs you will come to an underground stream. Notice the pool deposits have given way to rimstone dams. Looking at the wall of the cave, observe the scallop pattern. Where the scallop is the steepest indicates the direction of the current of the stream. Which way have streams of the past traveled in the cavern? Also, animals that have adapted to life deep within the cave are referred to as troglobites. An example of this is the cave fish that you can see at the entrance of the cave.

Going up the stairs you will come to another chamber—the bottom of a sinkhole. Often, animals—including humans, have fallen into sinkholes unknowingly. One example lies in the corner—the shell of a turtle. Sinkholes are often representative of karst topography, so remember that in this part of the United States, where there are caves there are also sinkholes. Climbing the last set of stairs, your spelunking adventure has finished, but there is still much to explore in the exhibit just outside the cave's exit.