NPS Photo by Rick Wood

Present a Cave

Lesson Objective: After completing this cooperative learning activity students will be able to create an oral and visual presentation on a national park cave and karst resource.

Key Concepts: National Park Service cave and karst resources; investigation; cooperative learning.

Duration: 3-4 55-minute class periods

- 1-day for introduction and initial investigation;
- 1-2 days for research and project design;
- 1-2 days for class presentations.

Audience: Middle school and high school students

NPS Photo by Rick Wood

Present a Cave

Teacher Copy and Activity Fact Cards

PRESENT A CAVE: TEACHER COPY

Lesson Objective:

After completing this lesson the students will be able to create an oral and visual presentation on a National Park cave and karst resource.

Materials:

1. 1 National Park Service Caves and Karst Facts Sheet for each group (8 total fact sheets available).
2. Present a Cave: Investigation and Planning Worksheet for each student.
3. Peer Evaluation Form for each student.
4. Group Member Evaluation Form for each student.
5. Access to the internet (for additional research).

Teacher Instructions:

1. Divide the class into cooperative learning groups of 3 to 4 students.
2. Assign each group one of the fact sheets.
3. Ask the students to read the fact sheet as a group and take notes on important concepts using the Jigsaw Worksheet.
4. Using the worksheet, groups should also plan how they will visually present information about their topic to their classmates.
    a. Examples might include a poster, a diorama, overheads, a power point presentation, a brochure, or a picture book.
    b. Encourage students to be creative, but emphasize that they need to present the information in a way that provides their classmates with the key information of the resource.

c. Encourage students to include information on not only the cave formation topics, but also any other cultural or historic information relating to the cave.

5. Give the students adequate time to prepare their presentations.
   a. Presentations should include:
      i. General information on their designated cave and karst resource.
      ii. Information that incorporates their designated topic with what they have learned already about cave and karst formation, fossils, sedimentation, porosity, etc.
      iii. Pictures and/or illustrations of their cave and karst resource.
   b. Students will benefit from having a class period to do additional research via the internet.
      i. The Views of the National Parks website and the National Park Service Caves and Karst Program website can both be invaluable resources for additional information.

   The National Park Service Caves and Karst website: http://www2.nature.nps.gov/geology/caves/program.htm

   The Views of the National Parks website is located at: http://www2.nature.nps.gov/views/

6. At the end of each presentation, students will fill out a:
   a. **Peer Evaluation Form** for each group.
   b. **Group Member Evaluation Form** for each of their group members.

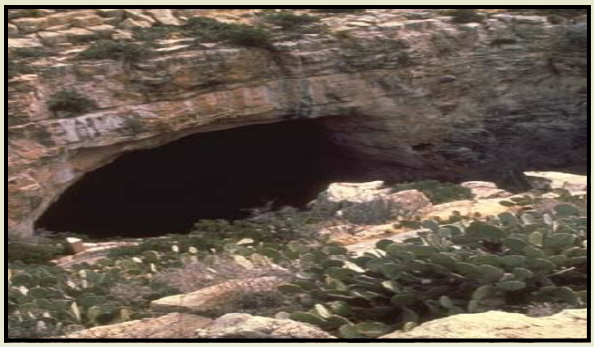
NPS Photo by Rick Wood

Present a Cave

Activity Fact Cards

Carlsbad Caverns . . . New Mexico

NPS Photo by Rick Wood



A Journey Underground

Your encounter with Carlsbad Caverns National Park begins near the Chihuahuan Desert of the Guadalupe Mountains. But beyond the somewhat familiar surroundings of rugged mountains and broad plains is another world. Away from the sunlight, away from the flowering cactus, away from the songs of the desert birds and the howl of the coyote, lies the celebrated underground world of Carlsbad Cavern. It is an incomparable realm of gigantic subterranean chambers, fantastic cave formations, and extraordinary features.

The Formation of the Cavern

The story of the creation of Carlsbad Cavern begins 250 million years ago with the creation of a 400-mile-long reef in an inland sea that covered this region. This horseshoe-shaped reef formed from the remains of sponges, algae, seashells and from calcite that precipitated directly from the water. Cracks developed in the reef as it grew seaward. Eventually the sea evaporated and the reef was buried under deposits of salts and gypsum.

Then, a few million years ago, uplift and erosion of the area began to uncover the buried rock reef. Rainwater, made slightly acidic from the air and soil, seeped down into the cracks in the reef, slowly dissolving the limestone and beginning the process that would form large underground chambers. Many geologists believe that the fresh rainwater mixed with deeper salty water to form sulfuric acid. The added power of this very corrosive substance could explain the tremendous size of the passageways that formed. The exposed reef became a part of the Guadalupe Mountains and the huge underground chambers far below the surface became the natural wonders of Carlsbad Cavern.

The Cave is Decorated, Drop by Drop

The decoration of Carlsbad Cavern with stalactites, stalagmites, and an incredible variety of other formations began more than 500,000 years ago after much of the cavern had been carved out. It happened slowly, drop by drop, at a time when a wetter, cooler climate prevailed. The creation of each formation depended on water that dripped or seeped down into the limestone bedrock and into the cave. As a raindrop fell to the ground and percolated downward, it absorbed carbon dioxide gas from the air and soil, and a weak acid was formed. As it continued to move downward the drop dissolved a little limestone, absorbing a bit of the basic ingredient needed to build most cave formations the mineral calcite. Once the drop finally emerged in the cave, the carbon dioxide escaped into the cave air. No longer able to hold the dissolved calcite, the drop deposited its tiny mineral load as a crystal of calcite. Billions and billons of drops later, thousands of cave formations had taken shape.

And, oh, the shapes they took!

Carlsbad Cavern photos from the National Park Service Digital Image Archives

NPS Photo by Rick Wood

Jewel Cave . . .

South Dakota

Exploring Jewel Cave

The exploration of Jewel Cave began about 1900 when two South Dakota prospectors, Frank and Albert Michaud, and a friend, Charles Bush, happened to hear wind rushing through a hole in the rocks in Hell Canyon. Enlarging the hole, they found a cave full of sparkling crystals. They filed a mining claim on the "Jewel Lode," but they found no valuable minerals. Therefore, instead of mining the cave they tried turning the cave into a tourist attraction.

The business was never a success, but the cave did attract attention. In 1908 Jewel Cave National Monument was established to protect the small but extraordinary cave. Fifty years later exploration of the cave suddenly intensified.

Into the Unknown

When Herb and Jan Conn were first persuaded to join a caving expedition in Jewel Cave in 1959, the couple responded without enthusiasm. Their passion was rock climbing, not crawling around in dark, gloomy holes. Little did they know they would spend much of the next 21 years in Jewel Cave, lured by the thrill of discovering the secrets of yet another mile of never before-seen cave.

“Our exploration of Jewel Cave, which started out as a mild diversion, quickly mushroomed into an all-absorbing interest," the Conns explain in their book *The Jewel Cave Adventure*. On a typical day, the Conns and their fellow cavers spent 12 to 14 hours underground. Outfitted in hard hats, carbide lamps, gloves, loose fatigues, elbow and knee pads, and boots, the explorers squeezed, crawled, and climbed their way through Jewel Cave's complicated maze. The going was rough. During rest stops they munched on mangled sandwiches and squashed fruit while massaging sore muscles. Names they gave to some passages, such as Contortionist's Delight and The Miseries, tell the story.

As years passed and more miles of cave were found, it became apparent that Jewel Cave was one of the world's most extensive caves, full of scenic and scientific wonders. The explorers found chambers with exquisite calcite crystals and rare cave formations. One much-decorated room discovered by the Conns - the Formation Room - is a highlight of the Scenic Tour today. They also found rooms as large as 150 by 200 feet, passageways as long as 3,200 feet, and a place where the cave wind blows at speeds of up to 32 miles per hour. The cave, they discovered, is truly a rare and precious jewel.

The caving parties led by this husband-and-wife team would make 708 trips into the cave and log 6,000 hours exploring and mapping. Modern-day cavers have discovered new wonders with more than 80 miles of passages, and today the cave is among the world's longest and is renowned for its variety of formations.

In 1980, after discovering more than 65 miles of cave, the Conns retired. A new generation of cavers has already pushed the known boundaries of the cave to more than 80 miles. But the mystery remains. As the Conns have said, "We are still just standing on the threshold."

Jewel Cave photos from the National Park Service Digital Image Archives

Wind Cave . . .

South Dakota

To witness the beginning of the formation of Wind Cave, one of the world's oldest caves, you would have to have been here 320 million years ago. At that time parts of the limestone that constitute the upper levels of Wind Cave were being dissolved into cave passage-ways. As ancient ocean levels fluctuated, these passages were filled with sediments. Beneath the ocean, a thick layer of sediments continued to be deposited above that limestone.

About 60 million years ago, the forces that uplifted the Rocky Mountains also uplifted the modern Black Hills producing large fractures and cracks in the overlying limestone. Over millions of years, water moving slowly through those cracks dissolved the limestone to produce the complex maze of the cave's passages.

Erosion later changed surface drainage patterns and caused subsurface water levels to drop, draining the cave passages. As the modern Wind Cave formed, many of these newer passages intersected the original cave, revealing the red clay and sandstone sediments from 320 million years ago.

It was after the cave formed that most of the colorful cave formations began to decorate its walls. One of the most prominent features in Wind Cave is **boxwork** (see photo below) - thin, honeycomb-shaped structures of calcite that protrude from the walls and ceilings. Nowhere else in the world can such a large display be seen. Some of the better known cave formations, such as stalactites and stalagmites, are rare here.

You might wonder if after more than 100 years of exploration there is anything new to discover in Wind Cave. Barometric wind studies estimate that approximately five percent of the total cave has been discovered. In 1891 Alvin McDonald wrote in a diary of his cave trips:

"*Have given up the idea of finding the end of Wind Cave.*"

The better equipped cavers of today have not given up. They are continuing to push farther and farther into the cave's cool, black recesses.

NPS Photo by Rick Wood

Photos from the National Park Service Cave and Karst Program

NPS Photo by Rick Wood

Timpanogos Cave . . .

Utah

Photo Source: NPS Digital Image Archives

Underground Delights

Some of the earth's most powerful and most delicate forces combined to create the wonders of Timpanogos cave, beginning when the Wasatch Range was building 65 million years ago.

Many different types of cave formations have been created by water simply dripping or flowing into the caves. Perhaps the most well known of these are stalactites and stalagmites, which can be seen throughout the caves.

Photo Source: NPS Cave and Karst Program

Stalactites, which hang like icicles from the ceiling, form as drop after drop of water slowly trickles down through the cave roof. The smallest stalactites may be hollow and as thin and straight as a soda straw (see photo on left), and so are called soda straw stalactites. Others may be massive: The Great Heart of Timpanogos in Timpanogos Cave - 5¼ feet long, 3 feet wide, 4,000 pounds - is composed of three, or possibly more, tremendous stalactites that have grown together. The many colors of stalactites, and indeed all of the formations in the caves, are caused by traces of iron, nickel, magnesium, and organics.

Stalagmites are formed when mineral-laden water strikes the floor. The tallest stalagmite is about six feet high in Timpanogos Cave; most are smaller. Occasionally stalagmites and stalactites merge, forming a floor-to-ceiling column.

The caves' largest column, 13 feet high, is found in Hansen Cave.

The Cascade of Energy and the Chocolate Fountain, both in Timpanogos Cave, are examples of still a different type of formation - flowstone. As its name implies, the smooth coatings or sculpted terraces of flowstone are created when water flows down a wall or across a floor.

Another common formation - draperies - are created when water trickles down an inclined ceiling. Water, flowing down a sloped surface, can form draperies. If the chemical content of the water changes, staining can cause it to take on the appearance of bacon (see photo on right). A spectacular example of such a formation is the Frozen Sunbeam, a thin translucent sheet of orange-colored calcite in Timpanogos Cave. Draperies in these caves are seldom more than one inch thick.

Photo Source: NPS Cave and Karst Program

Still another, not quite so common type of formation that occurs in the caves is cave popcorn. Popcorn occurs where water seeps slowly through walls or ceilings. These knobby lumps are particularly abundant in Timpanogos Cave, where they occur mixed with helictites.

Today, the caves still are changing: new formations are being created, and existing ones are growing where mineral-laden water continues to enter. As long as water - the master architect and interior decorator - continues to trickle into the caves, creation will continue.

Oregon Caves . . .

NPS Photo by Rick Wood

Oregon Caves may surprise you. Small in size, it is rich in diversity. That richness can be found both underground amidst narrow, winding passageways and above ground where old growth forest harbors a fantastic array of animals and plants found nowhere else. You will discover a land rich in conifers, wildflowers, birds, and amphibians. An active marble cave and underground stream reveal the inside of one of the world's most diverse geologic realms.

Photos from the National Park Service Cave and Karst Program

Discovery, Development and Rebirth

As his last match flickered out, 24-year-old hunter Elijah Davidson found himself in the total blackness of the cave. Davidson was chasing after his dog Bruno, who in turn was pursuing a bear. One following the other, the dog and bear entered a dark hole high on the mountainside. Davidson stopped at the mysterious dark entrance. He could see nothing, but an agonizing howl pulled him into the cave to save his dog. Now the matches were gone and Davidson was in total darkness. Fortunately, he was able to wade down a gurgling, ice-cold stream and find his way back into daylight. Bruno soon followed. It was 1874.

Later, other brave souls explored deeper into the cave, returning home to tell of its great beauty and mystery. In 1907, a party of influential men, including Joaquin Miller, the "poet of the Sierras," visited the cave. Charmed by it, Miller wrote of the "Marble Halls of Oregon." The ensuing publicity alerted federal officials to the possibility of preserving the cave. In 1909 President William Howard Taft proclaimed a

Oregon

area of 480 acres as Oregon Caves National Monument. In 1922 an automobile road reached the park, and 12 years later a six-story hotel, the Chateau, was constructed. The same year, 1934, Oregon Caves National Monument was transferred from the Forest Service to the National Park Service, which still administers it.

Workers blasted tunnels and widened passages in the cave during the 1930s. They put waste rocks in side passages, covering many limestone formations. Changes in air flow patterns altered the growth of formations and caused greater swings in temperature. Freezing water now cracked rock layers. Lights in the cave promoted the growth of algae, which turned portions of the cave green and dissolved some formations. Smoke from torches and lint coming off visitors' clothing blackened other portions.

Since 1985 the National Park Service has removed more than a thousand tons of rubble in its efforts to restore the cave. Transformers, asphalt trails, and cabins were removed to prevent sewage or oils from leaking into the cave from the surface. Thousands of formations buried under rubble were uncovered. Crystal clear water once again cascades over white marble. Some broken formations have been repaired with epoxy and powdered marble. Airlocks have restored natural cave winds by blocking airflow in artificial tunnels. Spraying with bleach keeps the algae under control. The new lighting and trail system will reduce evaporation and unnatural foods, which have attracted surface insects and driven out native species.

Not everything has been or can be restored. For example, the dissolution and formation of cave decorations are in delicate balance with the amount of carbon dioxide in the air and water. A global increase of this gas in the atmosphere, caused largely by deforestation and burning of fossil fuels, is affecting this balance. Still, one can now see a renewed cave, a valuable benchmark against which we can measure human impacts, now and in years to come.

NPS Photo by Rick Wood

Great Basin-Lehman Caves ...Nevada

Great Basin National Park

Great Basin National Park, established in 1986, includes much of the southern Snake Range, a superb example of a desert mountain island. From the sagebrush at its alluvial base to the 13,063-foot summit of Wheeler Peak, the park includes streams, lakes, alpine plants, abundant wildlife, a variety of forest types including groves of ancient bristlecone pines, and numerous limestone caverns, including beautiful **Lehman Caves**.

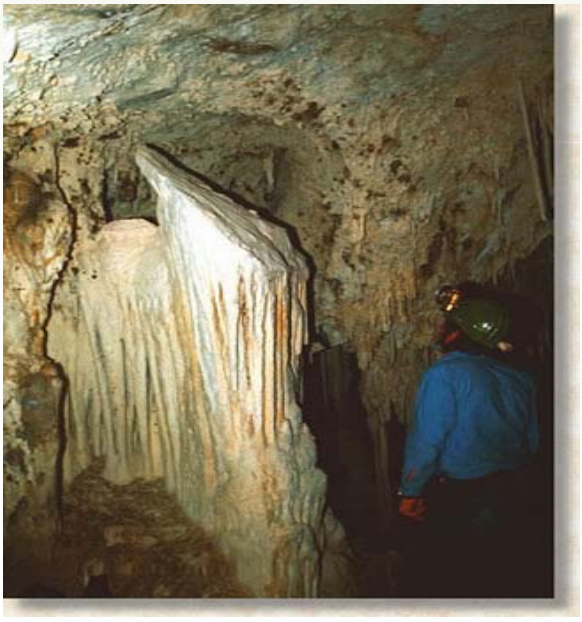
The Underground World of Lehman Caves

A single cavern, despite the name, extends a quarter-mile into the limestone and low-grade marble that flanks the base of the Snake Range. Discovered in about 1885 by Absalom Lehman, a rancher and miner, this cavern is one of the most richly decorated caves in the country, a small but sparkling gem.

What we see today began millions of years ago. The climate then was much wetter than it is now. Rain water, turned slightly acidic by seeping past surface vegetation and humus, found its way into hairline cracks deep in the native limestone. Trickling downward, the water dissolved the stone, enlarging the cracks, eventually reaching the water table. There it collected in sufficient quantity to create whole rooms. At one time, an underground stream flowed here, leaving behind tell-tale ripple marks.

Eventually the climate turned drier; water drained from the cave, leaving smooth walls and hollow rooms. Then came the second stage of cave development. Small amounts of water still percolated down from the surface. But now, instead of enlarging the cavern, the mineral-rich fluid began filling it once again. Drop by drop, over centuries, seemingly insignificant trickles worked wonders in stone. The result is a rich display of cave formations, or as scientists call them, speleothems. Lehman Caves contains familiar structures such as stalactites, stalagmites, columns, draperies, and flowstone, along with some interesting and delicate rarities.

Lehman Caves is most famous for the rare and mysterious structures called **shields (see photo below)**. Shields consist of two roughly circular halves, almost like flattened clam shells. How they are formed remains a subject of controversy - another of the pleasant mysteries to be found in the underground world.



Photos from the National Park Service Cave and Karst Program

Mammoth Cave...

Kentucky

NPS Photo by Rick Wood

NPS Photo by Gary Berdeaux

The Longest Cave:

The total surveyed extent of Mammoth Cave currently stands at 580 kilometers (360 miles) with potential for a 1600 kilometer (1000 mile) system. In addition, there are more than 200 caves within the park which are disconnected fragments of the larger system or associated with local drainage features. The geology and geography of the area has resulted in a variety of karst basins, which have become the most thoroughly understood conduit flow aquifer in the world.

Mammoth Cave Aquifer

Flow through the Mammoth Cave Karst aquifer can be very rapid, on the order of 1000's to 10,000's of feet per day. Contaminants entering the karst aquifer can thus be rapidly transported, unfiltered through the conduit system. The karst aquifer is very dynamic, that is, it responds nearly instantaneously to rainfall. The aquifer stage can rise 10's of feet in a matter of hours, with numerous records showing stage rises of more than 100 feet over the course of one day. Also, chemical and bacteriological properties of the groundwater can change dramatically following rainfall events.

Cave Entrances

Natural, modified natural, and artificial cave entrances pose some of the greatest challenges in the management of karst resources. This is because provision must be made for movement of air, water and wildlife within acceptable tolerances while simultaneously providing an adequate deterrent to illegal human entry. United States Fish and Wildlife Service- approved bat gates have been installed on the entrances of caves supporting major bat hibernation areas. Cave gates are designed to accommodate bat movement and natural rates of air exchange, provide greater security, and restore endangered Indiana and gray bat habitat. Airlocks have been installed on man-made entrances to restore cave atmospheric conditions.

Speleothems

Within the cave, a vast array of subterranean geologic features have developed over millennia, including stalactites, stalagmites, helictites, and travertine dams. There are also several types of gypsum formations, such as the aptly-named "gypsum flowers" (see photo below).

Photo Source: National Park Service Cave and Karst Program

NPS Photo by Rick Wood

Russell Cave . . .

Alabama

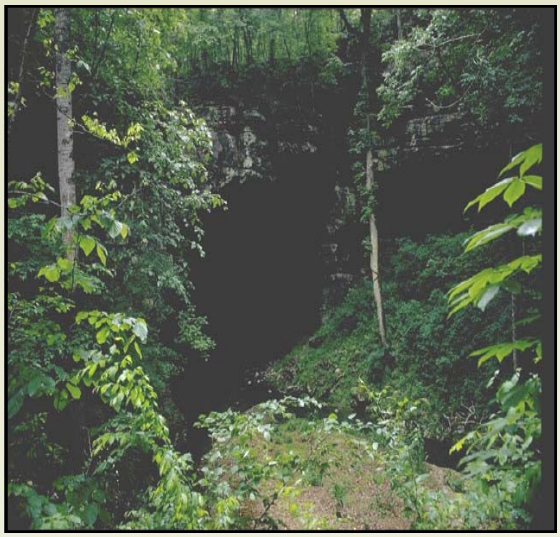


Photo Source: National Park Service Digital Image Archives

Indians Find Shelter in the Cave

Thousands of years ago nomadic bands of Indians stumbled upon Russell Cave in the hill country of northern Alabama. We know little about them except that they were few in number, probably less than 15 or 20, and that the only durable possessions they carried with them were a handful of chipped flint points with which they tipped their short hunting spears. These few possessions were found 12 feet below the present floor of the cave.

This evidence, supported by charcoal from their campfires, tells us that about 9,000 years ago these Archaic Period Indians first began to occupy Russell Cave. This is long before the rise of the civilizations of Egypt and the Near East. They could not have lived there earlier, because a stream of water filled the whole cavern until a great rock-fall from the roof shunted the stream to one side and raised the floor of the cave well above its waters. They lived there only during the autumn and winter seasons, maintaining their primitive existence by hunting game and gathering wild plants. Agriculture was probably known, but little used by the Indians of the Archaic Period.

The cave was a great boon to these Indians because it provided ready protection from the elements. This freed them from the need to build a shelter in the forest and gave them more time to find food. Successive bands of hunters with their women and children took shelter in this cave until A.D. 1000. The records of their seasonal occupations, including several burials of adults and children, have been uncovered by archeological digs. The charcoal from their fires, the bones of the animals they ate, the tools they fashioned from animal bones, their spear and arrow points, and their broken pottery accumulated layer upon layer as thousands of years passed.

The first party of cave dwellers camped on the irregular floor of rock slabs. Archeologists have been able to date the arrival of these people at some time between 6550 and 6145 B.C. by measuring the radioactive carbon remaining in the charcoal of their fires. Russell Cave was a seasonal haven for these early forest-dwelling Indians. They survived by hunting and gathering wild plants in the great hardwood forests of the region. After they had depleted the supply of animals and edible plants in one area, they would move on to another section of the forest.

Probably a number of related families used the cave as a place of shelter and safety mostly in the autumn and winter. The relative warmth of the cave probably prevented the stream from freezing and thus they had a constant supply of water. The forest bore a rich crop of nuts that must have been an important source of food during the worst winter months when game in this mountain-valley country was scarce. In spring and summer, small bands - several families - probably camped along the shore of the Tennessee River only a few miles from the cave. Fish, birds, and small mammals could be obtained in the river environment.

When the last occupants departed, Russell Cave held beneath its surface the record of at least 9,000 years of human life upon this continent.

Studies in historical geology and paleobotany have shown that the plant and animal life of the Eastern Forest Region remained virtually unchanged for thousands of years, until European settlers felled the trees for lumber and opened up extensive acreages for subsistence and commercial farming.