



Thank you to the Sierra Nevada Recreation Corporation: Moaning Cavern, Black Chasm Cavern and California Cavern for permission to use their classroom lesson plan material.

People & Caverns

Lesson 1: Living Conditions

Objective

Students will learn to understand the diverse uses of a cavern.

Background Information

Throughout history mankind has utilized caverns for numerous purposes. The dark, hidden, even-temperated spaces have had their practical uses. In addition, the mysterious subterranean chambers have inspired numerous myths and legends. Walking slowly into the unknown and inhospitable, haunted by eerily echoing dripping water, visitors have always had strong emotional reactions to caverns. It is not hard to understand why primitive people believed caverns to be places where evil creatures lurked, or magical events transpired.

Listed below are ways that people have used caverns:

PRACTICAL & EVERYDAY USES

- Primitive people used caverns for shelter, refrigeration of their food, and as cemeteries
- In the past, caverns with their forbidding, dark interiors and complicated, hard-to-navigate passageways were sometimes used as jail cells
- Bat populated caverns have been mined for bat guano which makes an excellent fertilizer
- Geologists have learned much about the history of the earth by studying the exposed geological layers in caverns
- During the Revolutionary War, caverns were mined for saltpeter, an ingredient in gun powder
- Mushrooms, which require darkness and humidity have been grown commercially in caverns

COVERT USES

- Caverns have made great hiding places for fugitives from the law, notorious among them, Black Bart who hid out at California Cavern, and Jesse James who made Meramec Caverns in Missouri his hiding place.
- With often concealed entrances and dark, enclosed interiors, caverns have made excellent venues for secret meetings. At California Cavern, the "Know Nothing" political party held its clandestine meetings there in 1855.

CEREMONIAL USES

- Primitive people used caverns as places for sacrificial ceremonies, and to record their histories with colorful pictographs (see supplemental handout for more information and activities concerning cave drawings)
- Young people from ancient times to the present day have used the mystery of caverns to create tests of bravery and coming-of-age tests
- Caverns have been used as beautiful and unusual venues for acoustically rich church services, marriage ceremonies and community dances

PROTECTIVE USES

- During the Civil War, slaves escaping the southern states utilized what was called the "Underground Railroad" - the excellent protection afforded by hidden caverns
- During the two World Wars, emergency plans for the protection of the population included using caverns as bomb shelters

ENTERTAINMENT/ADVENTURE USES

- Spelunking trips are physically and emotionally demanding, making caverns a great destination for adventurous people. Families enjoy taking walking tours along trails in caverns, viewing the beautiful crystalline formations and learning about their geological formation
- People who have a passion for caverns have purchased karst land and developed trails in caverns to make it possible for the general public to visit and enjoy them.

At Sierra Nevada Recreation Corporation, our caverns were used in many ways before they became show caves:

Boyden Cavern is located at the bottom of Kings Canyon, Sequoia National Forest. The entrance is an opening in the side of the giant "King's Gate" marble mountain next to the Kings River. While there are no artifacts to prove it, it is quite possible that the cavern could have been used as temporary shelter by local native Americans.

The first visitors to Moaning Cavern were most likely people who fell in accidentally. Over one hundred human skeletons as well as animal skeletons have been found at the bottom of the main chamber. Testing shows that the skeletons are over ten thousand years old - possibly the oldest human remains in North America. In the 1850's gold miners searched the cavern in the hopes of striking it rich. There was little gold to be found and thankfully the cavern was not destroyed in their search. Artifacts from both the primitive people and the miners are on display at the visitor center.

California Cavern also had ancient visitors. Human skeletons were found in the cavern in the fetal position with no clothing, tools or signs of fires. This leads scientists to believe that they were put into the cavern alive, possibly as prisoners. In October 1850 the cavern was discovered by a miner from a nearby mining encampment. Soon the cavern was open to the public for tours (California Cavern was the state's first show cavern). The mining town that grew next to it was named Cave City. The townsfolk used the cavern as a cool place to hold socials, church meetings and weddings.

Experiments & Activities

Grades K – 4 "In The Beginning"

Primitive people who lived in caverns created the first tools and utensils. If possible, take the class outside, away from any structure, to set the atmosphere. Have the students imagine living in a cavern without any of the modern conveniences they are used to. Discuss day-to-day activities that require tools or utensils (for example, gathering food, then preparing and eating meals, writing, washing clothes, etc.) and discuss how to go about doing these activities without our modern tools. Encourage the students to invent tools. Ask them what materials they would use and how their inventions could be created without modern tools to help.

Grades K – 4 "Record History"

See supplemental handout for information and activities

Grades 5 – 8 "Explaining the Mysterious"

Have the students write a story creating a legend that includes a cavern.

Grades 9 – 12 "Shelter"

Research why a cavern is not a good fallout shelter.

Grades 9 – 12 "Geological History"

Research how caverns are helpful to geologists in studying the earth's history.

People & Caverns

Lesson 1 Supplement: Cave Art

Background Information

There are three forms of cave art . Although these art forms are in use today, we associate them mainly with ancient people - as methods for recording spoken history.

PICTOGRAPHS – images painted on a rock surface (cave or otherwise). Numerous pigments and methods of application were used in this type of cave art.

PETROGLYPHS – images created by cutting a rock surface. Artists used tools to scratch, groove, drill or peck at the rock.

PETROFORMS – images created on the earth's surface by placing rocks in a pattern. These may be small, simple images or large (up to many acres) and/or complex. (Some designs are easier to see from the air.)

Of these forms of cave art, pictographs are the best known and the most fragile. The protected cavern environment has been essential in conserving these delicate ancient images.

Listed here are several sources for pigment and stains that ancient people used:

clay (red); bird droppings (white); charcoal (black); graphite (black); chalk (white); manganese ore (black); iron ore (red & brown); berries; other plants

These pigments were mixed with another ingredient to create a paint texture. Some of these paint "binders" included:

plant juice/oil ; animal fat/oil; glue from hides; egg whites; blood; urine; water

The pigments were mixed with the binder using grinding stones, sticks, etc. Possible containers were:

gourds; bark trays; stone bowls; clay pots; large leaves; shells; turtle shells; skulls

Tools to paint with included:

hands and fingers; pointed bones; sticks; quills; feathers

Brushes were made from:

hair; fiber; chewed twig ends; fur; moss; hide

Chunks of charcoal were used directly on rock like a pencil

Hollow reeds were used to blow powdered pigments (like spray painting)

Experiments & Activities

All Grades: "Become a Cave Artist"

Materials

Brushes

Option 1: sticks (dowels or twigs); scraps of fabric ;glue

Option 2: craft brushes; Q-Tips

Paint

Option 1: red clay; powdered chalk; water; bowl; wooden spoon

Option 2: tempera paints

Painting Canvas

Option 1: fist-sized or larger rocks

Option 2: brown paper bags that have been crumpled, soaked in water and dried flat, but not pressed (resembles a leather hide when ready.)

Procedure

If using Option 1, create brushes by spreading glue at one end of stick and wrapping fabric around it. Let dry while mixing paint. Carefully mix clay or chalk with water to create paint. Be careful to not add too much water or your paint will be a thin liquid.

Create drawings to tell the story of a special event (sports game, birthday, etc.)

While art is drying lead a discussion on the difference between ancient art materials and modern artists' tools.

Extensions

Discuss the differences between ancient cave art used to record history and modern methods of recording history (photographs/videos, books, statues, etc.)

Note: pictures of actual cave art would be an excellent addition to this lesson.

People & Caverns

Spelunking or Cave Exploration



Objective

Students will learn to understand the necessary precautions for exploring caverns.

Background Information

Even though all caverns are underground cavities with some similar features, each one is uniquely different. Some may be horizontal, some vertical or diagonal or contain a variety of chambers and passages. There may be no way to tell what a cavern is like from the outside. Will you need ropes and ladders? Is there an underground lake that must be crossed? Once you're inside, will there be multiple passages that could be confusing and cause you to get lost and not find your way out? What about lighting? There are, unfortunately, many sad stories of people entering wild caverns unprepared. Some never come back out. The sport of spelunking can be a dangerous one if you are not properly educated about caverns or have the appropriate equipment.

If exploring caverns sounds like an exciting hobby, you should first visit developed show caverns that offer spelunking trips. These caverns have professional guides to lead you through and teach important caving techniques. If you are still interested, do not go out and start crawling into any dark hole you find. There is still much you need to learn, and specialized equipment that you will need. Ask around about a local caving club, or contact the National Speleological Society for information on chapters near you. Joining a caving club will not only give you access to caverns that are not otherwise available to visit, you will also learn all the proper caving techniques needed to safely explore a cavern. Start with easy caverns and work up to more difficult ones.

Here are some important safety rules that every cavern explorer should follow:

- Never go into a cavern alone. It is best to go in groups of four or more, but too many people can also be a problem. Always try to go with someone more experienced than you.
- Tell a responsible adult who will not be accompanying you, where you will be and about what time you expect to be back.
- Have three sources of light and any replacement parts for them. If your light fails, sit down and wait for someone to come help you. Do not try crawling around in the dark.
- Be prepared for emergencies. Bringing a pack may be useful. It should contain the extra lights and parts, water, a snack food, first aid kit, and matches. Do not bring such a large pack that it is likely to become burdensome. Some crawlways will be so small that you will need to push or drag the pack. The pack will be banged around a lot, so it should be made of a rugged material, yet be flexible enough to fit through those odd-shaped crawlways. Remember, you will also have caving equipment to carry.
- Dress appropriately:

Always wear a helmet, even when the ceiling is high. Be aware of the possibility of falling rocks and

low ceilings. Be sure your helmet has a chin strap. You don't want it falling off your head into a pit where you cannot retrieve it.

Keep in mind that the cavern you choose to explore may have a cool environment. Even though you will be active, you may need to dress in two layers. The longer you are in a cool cavern the more your body temperature drops.

Sturdy shoes or boots are the best footwear. The various conditions in a cavern (water, mud, and sharp rocks) are not hospitable to open shoes like sandals. White-soled shoes are best since they will not leave marks on cavern rocks or formations.

Wear non-absorbent gloves. They will not only protect you, they will protect the cavern from you. If you touch a cavern formation with your bare hand, your natural body oils create a coating that prevents further growth. Wearing absorbent gloves may track mud and stains throughout the cavern.

Wear knee and elbow pads if needed.

- Never use questionable caving equipment. It could be unreliable.
- Be aware of weather conditions. Some caverns can fill with water quickly if a rainstorm hits. When first entering a cavern, look for possible areas of high ground just in case.
- Be aware of time.
- Know how long your light will last and keep track of time. Always take 3 times the expected amount of light capacity to be used. Make sure you exit the cavern well before the expected life of your lights.
- **If you take medication, either plan to be back on time to take it or bring it with you.**
- **Be aware of what time of day you will exit the cavern. Coming out after dark can be disconcerting when you are unfamiliar with the landscape. Pay close attention to where you park, the distance you walked from the car to the cavern, and what direction you traveled.**
- **Be alert:**

Do not drink alcohol or take medication when caving. You need a clear mind.

Do not go caving if you are not feeling well. You will not be as prepared as you should be, may actually damage the cavern environment, and could be a burden to your group.

- Never rely on a ball of string to mark your trail and never permanently mark on walls or features.

Of Sierra Nevada Recreation Corporation's four caverns, two: Moaning and California Cavern, offer wild cavern expeditions that take visitors beyond what is seen on the walking tours. These trips are lead by trained specialists who teach caving techniques, help protect the cavern environment and describe the history and geology of the cavern

Experiments & Activities

Grades K - 4 "Create a Cavern"

Line up the students' desks/chairs to form tunnels and have them crawl underneath.

Grades 5 - 8 "Create a Cavern"

In addition to requiring help from home, this activity takes extra work and more space than the K-4 activity. Students will need to bring the following items from home:

- a working flashlight
- a sheet (preferably dark).

In a large area use four-legged chairs, desks, and tables to create a meandering path (Chairs can be laid down on their faces so that they create small belly crawl areas and desks can be turned upside down to be crawled over). Cover as much of the structure as possible with sheets. Turn off the lights and let the students spelunk through their cavern using their flashlights.

Extension Project: let the other classes know ahead of time when you will be building your cavern and schedule appointments for them to visit your cavern. Your students could act as tour guides: issuing tickets, handing out flashlights, etc.

Grades 9 - 12 "Cavern Talk"

Contact a National Speleological Society (NSS) chapter near you and ask if someone could come to your school to give a talk and/or demonstration. In addition to bringing caving equipment, they may have slides to share. See the attached list of cavern organizations for the NSS address.

Grades 9 - 12 "Explore a Cavern"

If possible, the best learning experience is to actually do it. Find a show cavern that offers spelunking trips and make a reservation for your class to participate in one.

People & Caverns

Lesson 3 : Conservation

Objective

Students will learn to understand the importance of cavern conservation.

Background Information

A cavern is a fragile environment. That doesn't mean that it could easily collapse, it means that due to its essentially unchanging environment, any artificial changes may be quite devastating.

The beauty and mystery of caverns should be available for the enjoyment of everyone. However, carelessness and deliberate vandalism can ruin these precious natural environments for all of us.

Some of the ways people have knowingly damaged caverns include:

- Damming - Many cavern entrances are on the side of a valley with a river which eroded away the side of the cavern to create the entrance. When a dam is built and the water rises, it goes into this opening and floods the cavern. All cavern life is killed and formations are no longer able to grow.
- Vandalism – Selfish people thinking only of their own entertainment paint graffiti or carve on the cavern walls and break formations to take away as souvenirs.
- Mining – Some mining techniques such as quarrying break into caverns and destroy them. Sometimes caverns are specifically chosen to be mined for their beautiful formations that are broken out and sold.

There are many ways to damage a cavern without even realizing it:

- Lint from your clothing can fall off. While this in itself is not devastating, show caverns with thousands of visitors each year can leave behind quite a collection of difficult to clean lint.
- The beautiful formations in caverns are a draw to people. They want to reach out and touch them, and unfortunately, many people do. People have natural body oils and contaminants on their skin. Every time we touch something we leave a light coating of oil and contaminants.
- Speleothems grow by continual deposits of calcite. However, when the calcium solution encounters an oily spot, it slides off (just like when you wash your car and water beads up and slides off) Your oil has created a barrier that the calcite cannot cling to. In a sense, that area of the formation is now dead; it can no longer grow and the other contaminants will discolor the formation.
- Garbage is a more obvious contaminant, however, many people thoughtlessly drop their litter not realizing how it can negatively effect the cavern's ecosystem and formation growth.
- Without paying attention to their surroundings, people in caverns can make a careless movement that can destroy a formation in a split second which took tens of thousands of years to grow. One wave of the arm, standing up too soon in a low passage, or stepping on fragile formations without looking first - that's all it takes.
- Water pollution – You don't even have to be in a cavern to effect it with water pollution. When people dump garbage and chemicals in places other than approved dump sites, they may be doing so near a cavern without realizing it. Rainwater carries the contaminants and chemicals into the cavern where they can seriously harm or kill the cavern life. The polluted water then continues down to the water table and contaminates our drinking water.
- Improperly developed and maintained sewage systems can also drain into caverns, contaminating them and the water supply.

People who love caverns use the expression to "**cave softly**." This refers to being extra careful in and around caverns in order to not damage them or their inhabitants in any way. There are some basic rules that you can follow to be a safe and considerate cavern visitor:

- Do not touch any speleothem or formation with your bare hand.
- Move carefully. When exploring a wild cavern choose a path through the least sensitive area. Don't go where damage will be likely to occur. Remember, you do not have to explore everywhere in the cavern.
- Do not take any souvenirs – even already broken formations or artifacts. Leave the cavern as you found it, for others to enjoy.
- Bring out everything you took in and any other litter you find.
- Be aware of cavern life – before exploring a cavern try to find out what types of animals live there. Your presence can have a devastating effect. Hibernating bats will use energy they need to survive until spring if they are disturbed, and may die.
- When you need to mark your trail use removable trail markers. Do not make any marks in the cavern.

Cavers care about the preservation of these beautiful subterranean environments and embrace the motto:

"Take only pictures, leave only footprints, kill nothing but time."

Many cavers are revising this saying to be even more cavern friendly:

"Take nothing but pictures, kill nothing but time, and leave nothing - not even footprints."

While this is hard to achieve, cavers have found ways to leave no trace of their visit, honoring and preserving the pristine beauty of these protected natural environments. At Sierra Nevada Recreation Corporation, we are very committed to our conservation efforts:

When developing the caverns for access to visitors, great care is taken in avoiding delicate formations when installing walkways, stairs and lighting.

Visitors are not allowed to eat, drink, chew gum or tobacco, or smoke while inside the caverns. The organic garbage they may leave behind can be very harmful to the cavern's ecosystem.

Even with these precautions, some litter still finds its way into a show cavern. Our cavern naturalists are trained to remove anything that does not belong in the cavern, except artifacts.

Since a cavern is a dark place, the lighting installed to illuminate the beautiful cavern formations changes the natural cavern environment. With light, plant life such as algae is able to grow. Since this is not normal for the cavern, regular maintenance includes the removal of any plant growth. In addition, lighting is held to a minimum and all of the lights are turned off whenever there is no one in the cavern.

Experiments & Activities

Grades K - 4 "No Touching!"

Materials

- 12+ items of irresistible interest
- sheet
- mirror or glass with protected edges

Procedure

The first part of this activity is to help students conquer the urge to touch things.

- Spread the items on a table and cover with the sheet (possible items could include toys, candy, crayons, rocks, books)
- Have students stand around the table. Ask them to remember a time when they were told to not touch something and ask them what they did. Let a few tell their stories of how they sneaked a quick touch anyway.
- Explain that this activity is a no-touching activity. Have them discuss possible ways that they can resist the urge to touch (hands in pockets or behind back, etc.)
- Uncover the items and have the students circle the table giving everyone the chance to see all the items up close. Then have them go back to their seats and cover the table again.
- Ask students to describe the items they saw by referring to color, shape and texture. This will help them learn that they do not need to touch something in order to observe and understand it.

The second part of this activity is to show students how a simple touch can affect something.

- Pass the spotless mirror/glass around so that each student gets a chance to touch it.
- When you get it back, walk around showing each student all the fingerprints that are now covering it. These are the natural human oils and contaminants that we deposit each time we touch something. When touching a cavern formation, these oils actually prevent further growth. In a sense, a person kills the area of the formation they touch.

Grades 5 – 8

- Find out the proper places and procedures for disposing of waste.
- Play the Cavern Adventure Board Game included here.

Grades 9 – 12

- Develop a trash cleanup campaign in your community focusing on sewage problems, chemical dumping, etc. near waterways and karst areas.

CAVE RELATED ORGANIZATIONS

National Caves Association (NCA)

PO Box 625

Cobleskill, NY 12043

573-836-2256

www.cavern.com A non-profit organization of publicly and privately owned show caves in the US. The purpose of the group is to preserve and conserve these natural wonders. Cooperation and the exchange of information and ideas help members work together for the betterment of all aspects of the show cave industry and to better serve the public.

International Show Caves Association (ISCA)

Largo Leone XII

60040 Genga-Ancona, Italy

(39) 732-973315

www.i-s-c-a.com An organization of show cave operators from around the world. Their main objectives are to promote conservation and preservation of all caves while increasing public interest and promoting economic development of the member caves.

Bat Conservation International, Inc. (BCI)

PO Box 162603

Austin, TX 78716-2603

Phone 512-327-9721

Fax 512-327-9724

www.batcon.org A group of volunteers committed to the conservation of bats. Their mission statement is to protect and restore bats and their habitats worldwide. They are committed to teaching people to understand and value bats, protecting bat habitats, and advancing scientific knowledge about bats, their conservation needs and the ecosystems that rely on them through research.

National Speleological Society (NSS)

2813 Cave Avenue

Huntsville, AL 35810-4413

www.caves.org Members are cave enthusiasts who enjoy exploring wild caves and helping with cave conservation efforts. The group's programs include encouraging self-discipline among cavers; education and research concerning the causes and prevention of cave damage; and special projects, including cooperation with other groups similarly dedicated to the conservation of natural areas.

People & Caverns

Glossary

caving techniques: specialized methods of moving through a cave system in order to be safe and not hurt yourself or the cavern

conservation: preserving natural resources; the process of protecting something from loss or injury

contaminate: to make impure; to pollute

fragile: easily broken or damaged

geologist: a scientist who studies the physical nature and history of the earth

hibernate: to be dormant through winter. When animals hibernate they are not just sleeping. In order to conserve energy, their breathing and heart rate slow down considerably to the point that they may appear dead at first glance.

illicit: unlawful, illegal, not allowed

motto: a word or phrase that expresses the guiding rules and principles of an organization

primitive: ancient from the earliest times

sacrifice: giving something to a god as an offering

show cave: a cave that has been developed with paths and lights for people to visit

spelunking: exploring caves

vandalism: the willful and/or malicious destruction or damage to something

People & Caverns

Recommended Reading

Caves & Caverns – an activity book

by Kate Coder, Audrey Taylor, and Ann Molosky
Lincoln Caverns, Inc. ©1990
pages 2-5, 29

Caves

by Stephen Kramer
Carolrhoda books, Inc. ©95
pages 8-28

Our Planet – Caves

by Susan Rigby
Troll Associates ©94
pages 4-17

Looking Inside Caves & Caverns – X-Ray Vision series

By Ron Schultz
John Muir Publications, ©93
pages 4-10, 20-3

Caves – The Wonders of our World series

By Neil Morris
Crabtree Publishing Co. ©96
pages 4-15

Speleology - Caves and the Cave Environment

by George W Moore and Nicholas Sullivan
Cave Books, 64,78,97
pages 7-78

Caving

By Steven Boga
Stackpole Books 97
pages – 1-157 (spelunking), 158-174 (conservation)

Adventure of Caving – A Beginner's Guide For Exploring Caves Softly and Safely

By David McClurg
D&J Press 86
pages 30-218 (spelunking), 18-28 (conservation)

Caving Basics – A Comprehensive Guide for Beginning Cavers, Third Edition

G Thomas Rea
National Speleological Society 82, 87, 92
pages – all (spelunking)

People & Caverns

Word Search

L	S	B	C	W	F	E	R	T	I	L	I	Z	E	R
R	A	E	R	E	T	L	E	H	S	S	O	O	G	E
K	C	W	I	O	P	T	F	I	E	S	S	Q	A	T
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J	X	H	I	D	E	O	U	T	S	K	F	P	I	A

cemetery

law enforcement

saltpeter

ceremonies

mining

secret meetings

fertilizer

recreation

shade

fortress

refrigeration

shelter

give tours

research

spelunking

hideouts

sacrifice

storage

People & Caverns

Spelunking Maze

