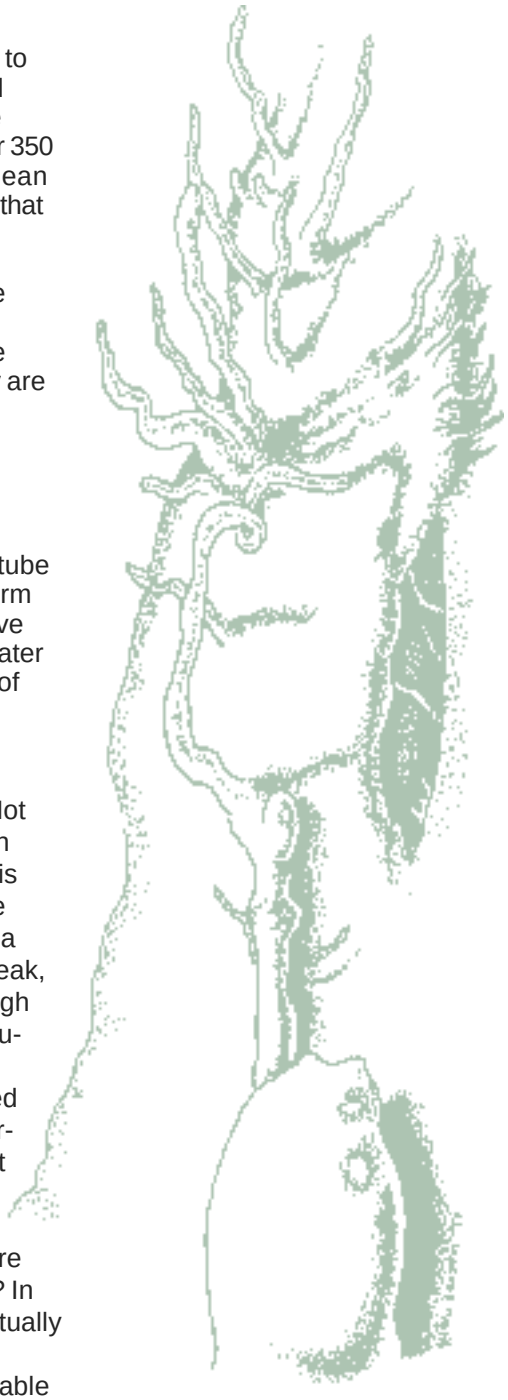
CAVES

CAVE DEFINITION AND TRIVIA

A cave is defined as a natural underground chamber open to the surface. There are over 40,000 known caves in the United States. The cave recorded as the longest in the world is the Mammoth Cave system in central Kentucky, which has over 350 miles of passageways. The world's deepest known cave is Jean Bernard Cave in France, which is 5250 feet deep. It is likely that even deeper caves will be discovered in the future.

Sarawak Chamber located in the Good Luck Cave in Malaysia is known as the world's largest cave chamber. The chamber is 2300 feet long and 390 to 1400 feet wide (place 7 football fields end to end and they still wouldn't quite fill up the whole thing). Mines are not considered caves because they are man-made.



TYPES OF CAVES

There are several types of caves. The vast majority are solution caves. These caves, usually limestone, are caves formed in rock that is dissolved by weak acidic water. Lava tube caves form during the cooling of lava flows and sea caves form from wave action. Talus caves form from huge rocks that have fallen off cliffs. Glacier or ice caves are formed by melting water moving through glaciers. Tectonic caves form by the action of earthquakes.

HOW SOLUTION CAVES FORM

Solution caves are formed by water. Just plain water? Not exactly. As plants and animals die, their remains are broken down by microorganisms in the soil. One byproduct of this is carbon dioxide. Water passing through the soil picks up the carbon dioxide. Carbon dioxide combined with water yields a weak solution of carbonic acid. Although this acid is very weak, it is enough to dissolve limestone. The solution seeps through the bedrock to a point where every crack or fissure in is saturated. This is the water table. Here the weak acid dissolves calcite, the primary mineral in limestone, creating water filled spaces. Dissolved areas range from widened cracks to enormous chambers. Dissolved calcite then joins the water as it continues through the bedrock towards surface outlets or underground aquifers.

Although many caves are filled with water, most of us are familiar with caves filled with air. So where did the water go? In some cases, the layers of bedrock encasing caves have actually moved, uplifted through mountain building processes, rising above the water table as a result. In other cases the water table itself has dropped as climates have changed. It is possible for a cave to have been filled with water, then dry, then filled again many times in its history.

CAVES

HOW SPELEOTHEMS FORM

Cave formations, or speleothems, are a result of a reaction that begins on the surface. The process that creates caves is quite similar to the process that decorates them. As explained above, water becomes acidic as it moves through soil and dissolves calcite as it seeps through the bedrock. As long as the water is in the bedrock or a water-filled cavern, the calcite will stay in solution. However, if the water meets with an air-filled cave, the calcite will come out of solution, being deposited on the cave ceiling, floor, or wall. The type of speleothem that forms depends on how the water comes into the cave. A drop clinging to the ceiling for some time will deposit calcite on the ceiling, beginning the formation of a stalactite. Water dropping quickly to the floor will deposit calcite that builds into a stalagmite. Water seeping through the cave walls will deposit calcite in the form of popcorn or draperies. The rate at which formations grow is dependent on several factors including the amount of water flowing into the cave, the mineral makeup of the bedrock, and the acidity of the water solution.

NOTES:

CAVES

CAVE LIFE

Bats! Yes, bats, but they are only one kind of life using caves. And bats are not true cave lovers or troglophiles. Bats are troglozenes, cave guests. They spend only a fraction of their life in caves - as a roost site, maternity roost, or hibernaculum (winter roost site). Bats, like humans, must find their food and water outside the cave. Some caves have bat populations of 20 million, making caves a vital area for this beneficial but misunderstood mammal.For more information on bats, see unit 3.

The highest concentration of life in caves is near the entrance, where the nutrients are most plentiful. Food and energy available for cave life are limited further back in a cave. Organisms in remote areas of a cave are well adapted to the limited food supply. They are fewer in number and smaller in size to minimize competition with one another. These organisms have become expert scavengers, feeding on any available nutrients, including members of their own species.

Bringing food into a cave - even small crumbs - can upset the delicate balance that has evolved between cave life and available nutrients. The introduction of additional organic matter attracts invader organisms that take advantage of the foreign food supply and out-compete the native cave life, even pushing the native species to extirpation. The tie to the surface is a fine balance, and people - as visitors to caves - must be careful not to harm the fragile cave ecosystem.

HUMANS AND CAVES

People have used caves for as long as our species has existed. We have used them for shelter, religious purposes, mineral extraction, study and recreation. To different people, caves are places of adventure, places of mystery, places to fear, or places to find one's wealth, but until recently caves have not been thought of as places to be protected. Our lack of knowledge about the delicate ecology of caves has led us to disturb the natural balance of many caves around the world, including here in the Great Basin. Cave decorations (speleothems) have been removed as souvenirs, and vandalism marks the walls of many caves. Paved trails and electric lights make caves accessible to thousands of visitors, but both the infrastructure and increased visitation is detrimental to cave ecosystems. Touching cave formations discolors them and stops growth. Lint from clothing coats walls and formations, changing the very "fabric" of the limestone. Electric lights show off the beauty of caves, but also promote desiccation and algae growth. Debris brought in on shoes can change the chemistry of pools and upset the nutrient balance. Anything brought in from the surface affects everything under the surface.

Not all human interaction with caves has been negative. Researchers have learned much about the geological history of the earth, gleaned important data about past global climates, and discovered new medicines from cave organisms. Commercially developed caves are now managing the numbers of visitors into caves and are taking measures to reduce human impacts on caves. What more can be done to protect these fragile, natural underground chambers?

Practice "Leave No Trace" techniques. Stay on developed trails or paths; do not touch cave formations, and do not introduce foods or other organic material into a cave. Educate others about the true nature of caves. Take only pictures and leave the caves just as you find them. Check with the cave owner (public or private) before entering a cave. Obtain permission and the proper permits. Respect the decisions of cave managers who close caves during certain times of the year for resource and visitor protection. You are a surface tie to a complicated and fragile underground environment. With your help, the delicate balance that keeps caves healthy will be guaranteed for generations to come.

CAVES

WHAT CAN YOU DO?

1) PRACTICE "LEAVE NO TRACE" TECHNIQUES.

2) STAY ON DEVELOPED TRAILS OR PATHS.

3) DO NOT TOUCH CAVE FORMATIONS.

4) DO NOT INTRODUCE FOODS OR OTHER ORGANIC MATERIAL TO THE CAVE.

5) EDUCATE OTHERS ABOUT THE TRUE NATURE OF CAVES.

6) TAKE ONLY PICTURES AND LEAVE CAVES JUST AS YOU FIND THEM.

7) CHECK WITH THE CAVE OWNER (PUBLIC OR PRIVATE) BEFORE ENTERING A CAVE.

8) OBTAIN PERMISSION AND THE PROPER PERMITS TO ENTER A CAVE.

9) RESPECT THE DECISIONS OF CAVE MANAGERS WHO CLOSE CAVES DURING CERTAIN TIMES OF THE YEAR FOR RESOURCE AND VISITOR PROTECTION.

10) REMEMBER, YOU ARE A SURFACE TIE TO A COMPLICATED AND FRAGILE UNDERGROUND ENVIRONMENT. WITH YOUR HELP, THE DELICATE BALANCE THAT KEEPS CAVES HEALTHY WILL BE GUARANTEED FOR GENERATIONS TO COME.

GROW YOUR OWN

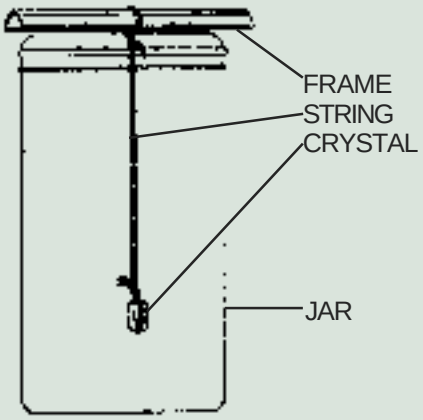
ACTIVITY 1

SUBJECT:
Chemistry

LOCATION:
Classroom

DURATION:
4-7 days for entire process

OBJECTIVES:
Students will create and observe crystals "growing" in the classroom. Students will experience the importance of accurately performing scientific experiments.



BACKGROUND:
Speleothems are formed by calcite crystals. A crystal is a body formed by the solidification of chemical elements or compounds that have a regularly repeating arrangement of atoms. To understand how minerals behave in solution and the formation of individual crystals, grow your own!

KEY VOCABULARY:
Crystal, saturated solution, mineral, faces, speleothem

MATERIALS:
Alum, string or wire, jars, saucers, and cloth pieces

METHOD:
1) Purchase white or chrome alum from a local pharmacy or a chemical supply house. BE CAREFUL! Wash hands thoroughly and be sure to wash all containers before you begin and after you complete the process.
2) Dissolve four or five ounces of alum in a pint of water and heat it. (Do not let it come to a boil!) Add more alum until no more dissolves. You have created a "saturated solution".
3) Remove from heat and pour a little into a saucer or flat pan. (Enough to cover the surface of the saucer or pan) Place in a cool, dark location, such as a cabinet.
4) Pour the remainder of the solution into a clean glass jar and cover it with a cloth. (The cloth prevents it from becoming contaminated by dust or molds but still allows air to escape.) Place the jar in a protected location where it will not get bumped, spilled, or dropped.
5) Check the saucer in 2-3 days. When the crystals are at least 2-3 mm across, pour off the extra liquid and dry them off on a piece of tissue. These are now your "seed crystals".
6) Pour your main solution from the first jar into a clean jar. Leave any crystals that may have formed on the first jar behind.
7) Suspend one of the "seed crystals" (the best and largest) in the solution you have just transferred into the new jar. (See the diagram to construct a wire/string frame to suspend it from.) Make sure that all of the wire is below the surface.
8) Cover the jar again with a piece of cloth and set aside. Check your crystal periodically to observe its growth. You may wish to keep a daily log of its progress.
9) When the crystal stops growing, you can dry it on a tissue. Take careful measurements and record its size. Write up a brief descriptive report on the crystal and the experiment. Draw a picture to add to the report. This will help you concentrate on the faces and angles of your crystal.

HINT: The solution must be saturated or it will dissolve the crystal instead of making it grow

DON'T TOUCH!

ACTIVITY 2

SUBJECTS:
Science, math

LOCATION:
Classroom

DURATION:
30 minutes

OBJECTIVE:
The students will be able to describe why touching speleothems is damaging.

BACKGROUND:
Oil and dirt from people's hands can damage speleothems. By simply touching the speleothem, these oils are left behind. This can dull the color of the speleothem, sometimes staining it. Touching can also stop the growth of speleothems. Since speleothems are formed with water, oil from people's hands can create a barrier that does not allow dissolved minerals to continue to deposit.

MATERIALS:
Mirror

METHOD:
1) Ask the students to each touch the mirror (this works best after lunch or recess when their hands are probably dirty or sweaty).
2) Show the class the mirror with all the finger prints on it. Explain that they have changed the appearance of this mirror, and while a mirror can be cleaned with a cleaner, speleothems in a cave cannot. Why would you not want to use cleaners such as Windex to clean cave speleothems?
3) Lead a class discussion with the following: Lehman Caves in Great Basin National Park averages 34,000 visitors a year. If 5% of those 34,000 people touched a cave formation, how many people would be leaving their oily fingerprints on the formations? Do you think that many people touching the formations hurts the cave? Why? Do you think the "don't touch rule" is a smart one? How would you encourage people not to touch the cave formations?

EXTENSION:
Schedule a field trip to Great Basin National Park. Have a ranger lead the class on a cave walk, discussing damage done in the past and what we have learned about protecting the cave. Discuss what we can learn about protecting our world on the land's surface by what we see and learn underground.

To schedule a field trip, please contact the Education Coordinator at Great Basin National Park. Call (775) 234-7331 for reservations and more information.

PROTECTING CAVES

ACTIVITY 3

SUBJECTS:
Science, math, social studies

LOCATION:
Classroom

DURATION:
1 hour

OBJECTIVE:
Using their own words, students will be able to explain reasons why people should not remove rocks, speleothems, or other features from caves.

BACKGROUND:
Caves are fragile ecosystems that can easily be destroyed if visitors in those caves are not conscientious.

KEY VOCABULARY:
Cave, speleothem

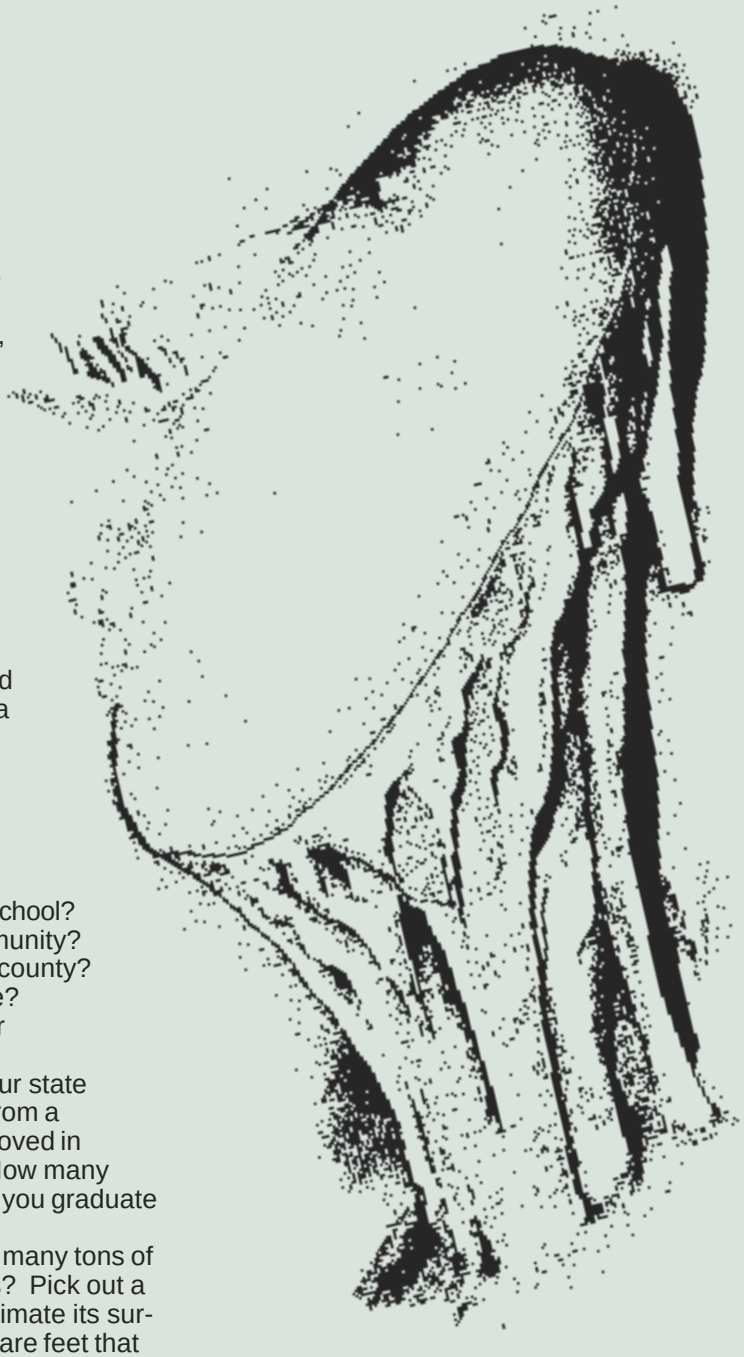
MATERIALS:
Copies of mathematical exercises listed below, rocks from local area (not from a cave or park!), scale, measuring tape.

METHOD:
In groups or individually, have students complete the following mathematical exercises:

1) How many classes are there in your school? How many schools are in your community? How many communities are in your county? How many counties are in your state? (These totals reflect the total number of school classes in your state.)

2) If each year each school class in your state (calculated in #1) removed 4 rocks from a cave, how many rocks would be removed in a year? In 5 years? In 10 years? How many rocks would be removed by the time you graduate from high school?

3) If each rock weighed 3 pounds, how many tons of rocks would be removed in 10 years? Pick out a rock. How much does it weigh? Estimate its surface area. Figure out the area in square feet that would be missing from the cave yearly if each class in your state removed rocks of similar size. How does this compare to the area of your classroom floor?



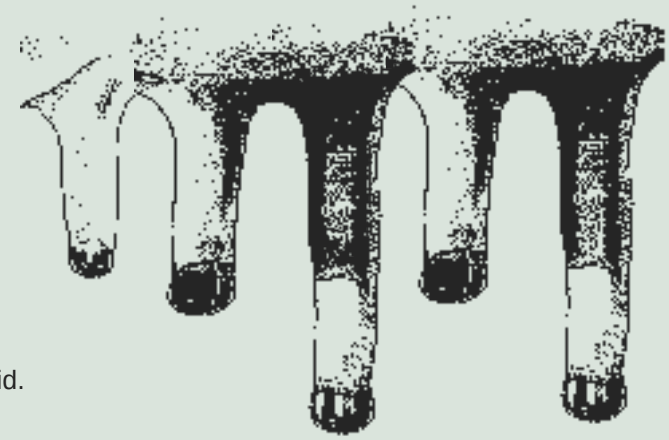
DISSOLVING LIMESTONE WITH ACID

ACTIVITY 4

SUBJECTS:
Science

LOCATION:
Classroom

DURATION:
30 minutes to 1 hour



OBJECTIVE:
Students will use the trial and error method to test which rock or shell samples react with hydrochloric acid.

BACKGROUND:
Limestone is the most common cave forming rock, composed of a mineral called calcite. When carbonic acid in water comes in contact with calcite, the calcite begins to dissolve. A similar and faster chemical reaction occurs with stronger acids, such as hydrochloric acid. Cold dilute, hydrochloric acid will produce a bubbling reaction upon contact when calcite is present in any object.

KEY VOCABULARY:
Hydrochloric acid, calcite, carbonic acid

MATERIALS:
For each student: pencil, safety glasses or goggles.
For every two students: one copy of the Reaction Chart (following page), a bottle of hydrochloric acid (HCl), a jar or beaker, dropper.
For the class: rock samples of limestone, granite and sandstone; seashells, paper towels.

METHOD:
In pairs, students will place drops of cold, dilute hydrochloric acid on rock/shell samples, then record the results. They will form a conclusion as to their findings of which samples reacted and why, then write their conclusions on the work sheet provided.

1) Read directions for safe handling of acid. Explain safety procedures to be followed in the classroom. Acid will burn skin and clothing!
2) Copy work sheet/chart on following page - enough for 1 copy for every 2 students.
3) Mix a solution of water and HCl in a ratio of 10 to 1 (10 parts water to 1 part HCl).
4) Label rock samples “A”, “B”, “C”.
5) Using the dropper, place one drop of HCl on each rock sample.
6) Observe what happens and record observations in the proper column (acid reaction or no reaction).
7) Wipe acid droplets off samples with paper towels. Be careful not to get acid on your hands.
8) Test a seashell with the acid.
9) Record conclusions on the reaction chart.

DISSOLVING LIMESTONE WITH ACID

ACTIVITY 4

REACTION CHART

ROCK SAMPLES	ACID REACTION	NO REACTION
A.		
B.		
C.		
SEASHELL:		

CONCLUSIONS:

LET'S MAKE A CAVE

ACTIVITY 5

SUBJECTS:
Science, physical education

LOCATION:
Classroom

DURATION:
60 - 90 minutes

OBJECTIVE:
Students will learn the value of speleothems and will avoid touching artificial speleothems while using large motor skills to negotiate an obstacle course.

BACKGROUND:
Speleothem is the name given to any secondary deposit (decoration) inside a cave. The main types are stalactites (which hang down from the ceiling) and stalagmites (which rise up from the floor). Formation of any speleothem takes an extremely long period of time. As each drop of water leaves a tiny amount of mineral residue on a cave ceiling, floor, wall, or other feature, it adds to speleothem growth. When a speleothem is broken, it will not be replaced within our lifetime, if ever. Therefore cavers must be extremely careful while exploring.

KEY VOCABULARY:
Cave, exploration, speleothem, stalactite, stalagmite

MATERIALS:
Large cardboard box (such as furniture or appliance box), yarn, large nail, large plastic cups, plastic drinking straws, wooden dowel (height of the box width), tape.

METHOD:
1) The cave obstacle course is made up of drinking straw stalactites, plastic cup stalagmites, and a large card board box. Lay the box down so the two ends are open. Brace the center of the box with the wooden dowel "column". Punch a hole in the top of the "cave" with the nail. Thread yarn through one drinking straw and then through the nail hole and knot to secure it. Hang numerous straws, at various levels, in one area of the cave. Allow enough room for the students to wriggle around without touching them. Make the stalagmites by taping large plastic cups together end to end, or mouth to mouth. Stalagmites can be one to three cups high. Outside of the box, mark a trail with the stalagmites leading to one open end of the box, through it, and out the other end to represent an area of the cave where the explorer can stand upright. The cavers will need to crawl through the box.
2) Instruct students that they are to be cavers exploring a little known cave. It is their responsibility to not damage any speleothems. Briefly talk about stalactites, stalagmites, columns and other cave decorations to familiarize students with the terms.
3) Individually the students will approach the "cave" in an upright position being careful not to kick any stalagmites. When they reach the box, the students will crawl through, not hitting any stalactites or stalagmites. When each student has had a chance to negotiate the cave, lead a short discussion on maneuvering methods that the students invented or used. Have the students try another trip through the cave to see if there has been any improvement from their first trial.