

CREATE A CAVE

BACKGROUND INFORMATION:

Kartchner Caverns was formed by the **dissolution** of limestone. Limestone is composed of the mineral calcite (CaCO₃). Limestone is formed by the accumulation of calcite, which is inorganically precipitated as well as contained in the skeletons of once living sea animals and plants. Pieces of the animal skeletons and plants fell to the bottom of the sea and were later pressed down and cemented into hard rock. Finally, mountain-building forces uplifted these sedimentary rocks from the sea and exposed them to air and the dissolving power of fresh water. Water **seeps** and **percolates** into the soil. Limestone caves are formed when a mild acid reacts with calcite. This acid is carbonic acid (H₂CO₃), produced when carbon dioxide combines with water. Most of the carbon dioxide responsible for the acid that dissolves limestone comes from the soil.

The cave forming process may continue for thousands of years. It can be stopped by only two things: a lowering of the water table, or the introduction of outside air in the cave system by wearing away of the surface. As outside air enters the cave system, the water quickly becomes supersaturated with calcite, ending the dissolving process. This change usually marks the beginning of the **deposition** of calcite in the form of stalactites, stalagmites and other deposits, known as **speleothems**.

The limestone rock in which Kartchner Caverns formed was faulted and created cracks and fractures which allowed water to seep in and begin the dissolution process. The water drains slowly downward and sideways towards a

drainage point. As the water dissolved the limestone along the fractures it created passageways that are surrounded by undissolved rock.

SUMMARY:

A “cave” is created when sugar cubes, beneath a layer of modeling clay, becomes saturated with water. **Create A Cave** may be conducted as a whole class activity or you may get more of the materials and have the students work in groups. The groups could then compare their caves.

STEP BY STEP:

1. Organize sugar cubes into a half pyramid, about 3 cubes wide, that fits against the inside of a glass aquarium. The sugar cubes represent the limestone.
2. Seal the cubes tightly with approximately 1/8 inch layer of modeling clay, making sure there are no gaps. The clay represents the top soil. This simulates the limestone hill above Kartchner Caverns.
3. Poke holes through the top of the clay with the tooth pick, making sure the holes go all the way through to the sugar cubes.
4. Pass out work sheet, if using with older students, and review the equipment and steps which creates the model.
5. Have the students make a drawing of the model.
6. Next have the students predict what will happen when water is sprayed over the top of the clay. The water represents rainfall.
7. Use the spray bottle with water and begin spraying the top of the clay. The holes may need to be made a bit bigger to get the water percolating.
8. As the water penetrates the sugar, have the students describe what they are observing.

SUBJECT: Cave Origins

MATERIALS: one box sugar cubes, 2 pounds modeling clay, one aquarium, toothpick, spray bottle, transparency of cave diagram, overhead projector, copies of worksheet

GRADE LEVEL: K-3

TIME: 30-45 minutes

OBJECTIVES: Students will observe, predict and describe the “passageways” which are formed when they create a model of a cave forming by dissolution of limestone.

CONCEPT: The dissolution of limestone creates tunnels or passages when cave is formed.

CREATE A CAVE

9. Have the students write what happened as the water began to seep into the sugar cubes and make a drawing of what the cave looked like when finished.
10. Use the transparency of the cave diagram and have the students explain how this process is similar to the dissolution of limestone which created Kartchner Caverns.

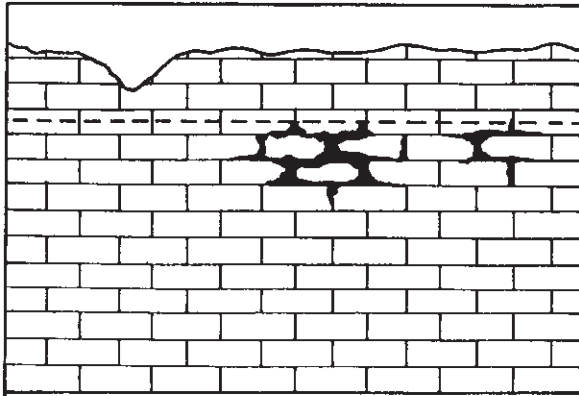
ASSESSMENT:

If this activity is being conducted as a teacher demonstration, discuss the contents of the transparency with the students and have them draw a picture of the process. If using with older students use the worksheet to assess their understanding.

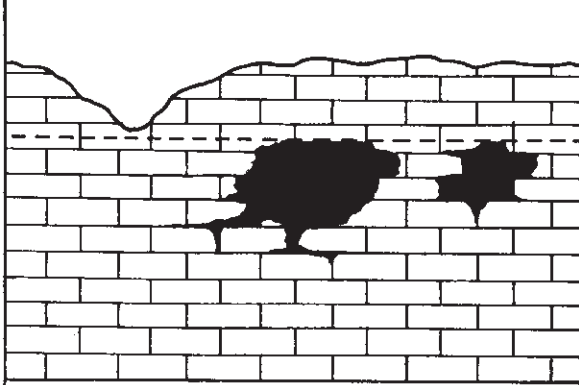
EXTENSIONS:

1. Continue the experiment over a couple of days, noting changes in the cubes and passageways.
2. Repeat with food coloring added to the water and get predictions of what will happen.

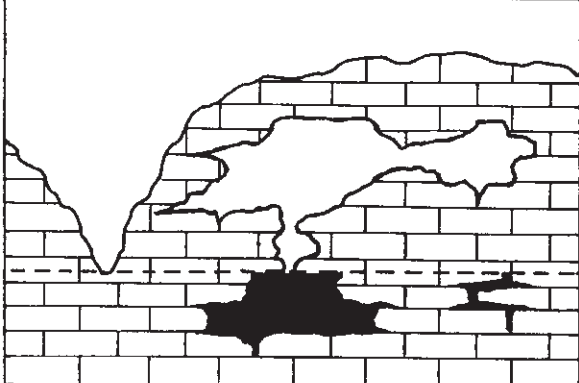
HOW KARTCHNER CAVERNS FORMED



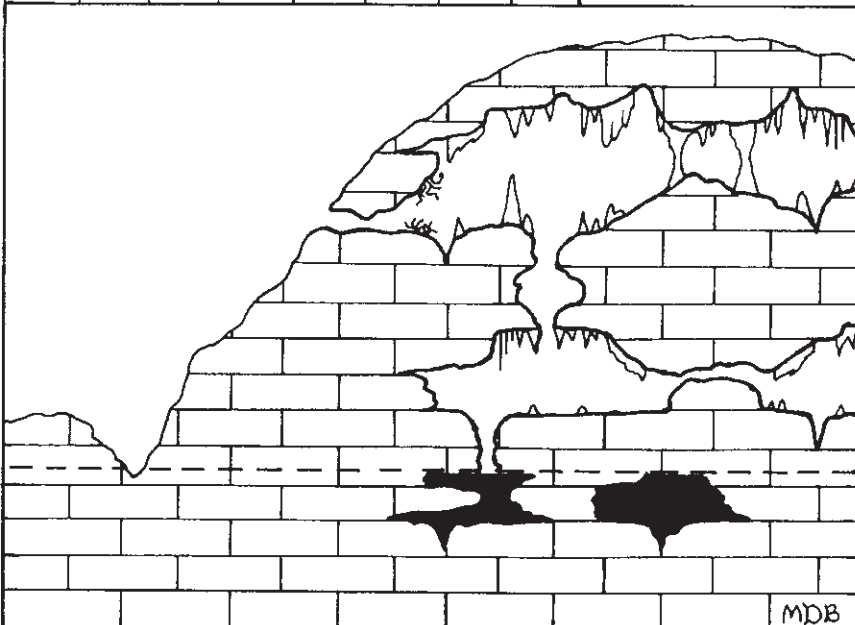
Stage 1: Underground water fills every crack in the rocks below the water table. Kartchner Caverns begins when cracks in the rock enlarge because of slowly moving acidic ground water.



Stage 2: The first large cave tunnels form when large amounts of limestone are dissolved by carbonic acid. Most carbonic acid is simply carbon dioxide (CO_2) dissolved in water. It is the same substance that gives carbonated drinks their "fizz."



Stage 3: As the water table drops, upper level passages become filled with air and lower level passages begin to form. Limestone is now dissolving rapidly because of the large amounts of CO_2 in the cave water and air. The cave has no entrance yet, and no cave decorations.



Stage 4: A small passage in Kartchner Caverns collapses, making an opening to outside air. It is at this point that cave decorations begin to form. Opening the cave is similar to opening a bottle of soda pop; the CO_2 bubbles out. When this happens, the water inside the cave is not as acidic and stops dissolving rock. In fact, minerals already dissolved in the water begin to be deposited. These eventually become stalactites and other cave decorations.