NPS Photo by Rick Wood

Making a Cave

Lesson Objective: After making clay models of caves students will learn about weathering processes and be able to conceptualize how water creates caves and cave formations.

Key Concepts: physical, biological, and chemical weathering; dissolution; precipitation; carbonic acid.

Duration: 1 55-minute class period

Audience: Middle school and high school students

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Making a Cave

Teacher Copy and Answer Key

MAKING A CAVE[1] - TEACHER COPY

Lesson Objective:

After making clay models of caves students will learn more about weathering processes, and be able to conceptualize how water creates caves and cave formations.

Background:

Weathering occurs when rocks and minerals are broken down into smaller particles or sediment. There are 3 different types of weathering: physical or mechanical, biological, and chemical. **Physical weathering**, also referred to as mechanical weathering, is when the shape or size of a rock is changed without changing the chemical composition. **Biological weathering** occurs when organisms assist in breaking down rocks into smaller sediments. **Chemical weathering** refers to the process when rocks react with water, solutions, or gases and their chemical structure is changed. During this process, elements may be added or removed from the rocks. This lab activity will focus on a chemical weathering process called dissolution.

Dissolution occurs when rocks are dissolved. Caves are formed when dissolved particles are washed away and leave hollow spaces behind. One type of rock that is easily dissolved is carbonate rocks, and caves are often formed in this type of sedimentary rock. **Sedimentary rocks** are formed when other rocks are broken down into smaller pieces, called sediments, and are then cemented back together as new rocks.

Precipitation is the deposit of water on Earth from the atmosphere, and can present itself as hail, mist, rain, sleet, or snow. Precipitation, such as rainwater or snowmelt, can pick up carbon dioxide from the air and also from decaying plants in the soil. When this water mixes with carbon dioxide it forms carbonic acid. The acidic water flows through cracks on the earth's surface and seeps down into the rocks below. There, carbonic acid dissolves certain kinds of rock, like limestone, which is a type of sedimentary rock. Once the acidic water reaches the carbonate rocks under the soil, it enters into the cracks and dissolves away the rock to create the rooms, passageways and speleothems of a cave.

[1] Activity adapted from *Exploring Caves and Karst: A Curriculum Guide* The American Cave Conservation Association. Inc.

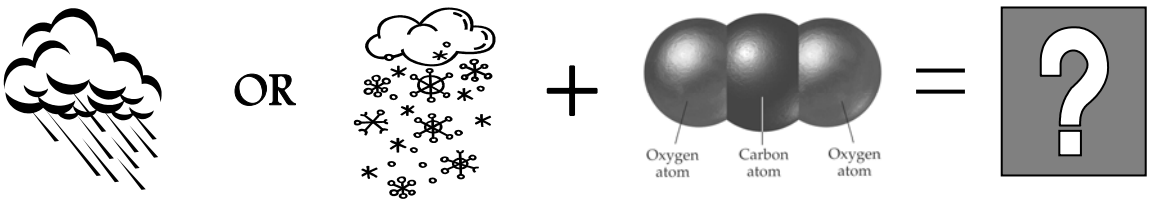
Test Your Cave Formation Knowledge:

A. Match the following terms with their definitions.

Matching Definition		Term
E	1.	Carbonic Acid
C	2.	Chemical Weathering
F	3.	Dissolution
G	4.	Physical Weathering
B	5.	Precipitation
A	6.	Sedimentary Rock
D	7.	Biological Weathering

	Definition
A.	This type of rock is created when rocks are broken down and then cemented back together as a new rock.
B.	The deposition of water on Earth from the atmosphere.
C.	A process that occurs when rocks react with water, solutions, or gases and their chemical structure is changed.
D.	A process that occurs when organisms assist in breaking down rocks into smaller sediments.
E.	This is produced when water mixes with carbon dioxide.
F.	The act or process by which rocks are dissolved.
G.	A process that changes the shape or size of a rock without changing its chemical composition.

B. Use the following picture clues to complete the sentence:



When *RAIN* or *SNOW* mixes with *CARBON DIOXIDE* it forms *CARBONIC ACID*.

Creating a Cave:

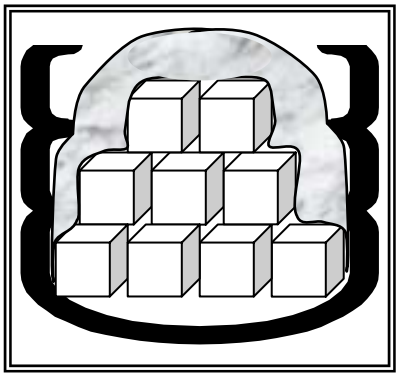
You will now make a cave using sugar cubes, modeling clay, and water.

- The sugar cubes will represent the limestone that comes into contact with the carbonic acid.
- The clay will represent the rocks that remain undissolved.
- The water sprayed on the cave will represent the carbonic acid found in precipitation.

Materials:

1. Modeling clay (4 oz. per student or small group)
2. Sugar cubes (3-6 per cave)
3. 1 see-through bowl per student or group (Cutting the top off of 2-liter bottles works well).
4. Toothpick
5. Spray bottle filled with warm water.

Procedure:



1. Organize the sugar cubes into a half pyramid along the bottom of the bowl.
    a. Make sure the sugar is pressed up against one side of the bowl.
2. Seal the cubes tightly with the modeling clay, making sure there are no gaps.
    a. The clay layer should be about 1/8 inch deep.
    b. The sugar cubes that are pressed up against the glass should remain visible. This will act as a window into your cave.
3. Poke holes through the top of the clay with the tooth pick, making sure that the holes go all the way through to the sugar cubes.

Questions:

- What do the holes in the clay represent?

  THE HOLES REPRESENT THE CRACKS AND HOLES IN THE EARTH'S SURFACE

- What do you think will happen to the sugar cubes when water is sprayed over the top of the clay? **Be specific**…what do you think it will look like?

  RESULTS MAY VARY

4. Use the spray bottle with warm water and begin spraying the top of the cave.
    a. The holes may need to be made bigger to get the water percolating.
5. As the water seeps through the clay and into the sugar cubes, record your observations below.
6. Continue spraying until the sugar cubes are no longer in their original shape or they have completely dissolved.

Observations:

1. Describe what happened to the sugar cubes as the water seeped into your cave.

RESULTS MAY VARY

2. Draw a picture or describe what your cave looked like when finished.

RESULTS MAY VARY

Interpretation:

Stalactites from Timpanogos Cave National Monument, Utah. NPS Photo

1. The caves of our National Parks house some extraordinary formations. How do you think water contributed to the formation of these real cave formations?

SIMPLE ANSWER:

AS WATER SEEPS FROM A CAVE CEILING IT DRIPS DOWN DUE TO GRAVITY. THE MINERALS IN THE DROPS ACCUMULATE AND CAN FORM FORMATIONS SUCH AS STALACTITES.

ADVANCED ANSWER:

THIN HOLLOW TUBES GROW FROM THE CEILINGS OF CAVES AS WATER RUNS DOWN INSIDE THEM AND DEPOSITS RINGS OF CALCITE AT THEIR TIPS. THESE ARE CALLED "SODA STRAWS". STALACTITES, WHICH ARE ICICLE-LIKE DEPOSITS, FORM AFTER THE CENTER OF SODA STRAWS BECOME PLUGGED AND CALCITE IS DEPOSITED ON THE OUTSIDE OF THE STRAW.