NPS Photo by Rick Wood

Growing Speleothems

Student Copy

GROWING SPELEOTHEMS

Lesson Objective:

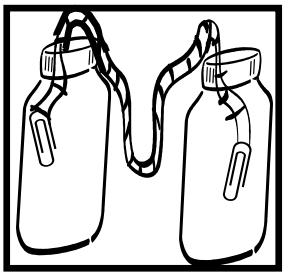
After completing this activity you will be able to understand and simulate the processes involved with speleothem formation, as well as plot data and extrapolate information from the graphs.

Materials – Each group of students needs:

- 1 cup of Epsom Salts
- 2 identical jars or disposable cups
- 1 spoon
- 1 saucer or piece of aluminum foil.
- Two paper clips
- 20 cm thick cotton string.
- Hot water
- Calculator

Procedure:

1. Pour warm water into the 2 jars until they are almost full.
2. Add half of the Epsom salts into each of the jars.
3. Stir until the solution is saturated. (Most of the Epsom salts will not dissolve and will remain at the bottom of the jars.)
4. Tie a paper clip to each end of the string
5. Wet each end of the string well with tap water.
6. Place the ends of the string into the jars.
    a. The paper clips should rest on the bottom of the jars.
7. Place the jars so that the string sags in the middle.



8. Place a saucer or piece of aluminum foil beneath the sag in the string.
9. Place your experiment in a location where it will be away from drafts and disturbance.
10. Use the rest of the class period to read the **Background** section on the following page and complete the questions.
11. Record your **Observations** at the end of Day 1 and Day 2 in the table provided.
12. Complete the **Results** and **Conclusions** section on Day 2.
13. After you have completed step 12, complete the **Solution Activity** at the end of the handout.

Background:

Carbon dioxide can enter the soil in different ways. One way it can enter the soil is from decaying organic material, like plants. As the organic material decomposes it releases carbon dioxide into the soil where it can interact with groundwater. Carbon dioxide is also found in the air, and may be picked up by rainwater as it falls to earth and then seeps into the soil.

When water and carbon dioxide combine they form a weak acid called **carbonic acid**. As the acidic water seeps through the soil it may flow down through bedrock and dissolve minerals, commonly calcite, along the way. When the water reaches a cave, the carbon dioxide in the water is released and the minerals are deposited on the cave walls, ceilings and floors as cave formations. This is the reason why so many cave formations consist of calcite.

Cave formations are referred to as "**speleothems**". The word speleothem is derived from the Greek words "spelaion" meaning cave, and "thema" meaning deposit. There are many varieties of speleothems, and some have been said to resemble beehives, toadstools, bacon, and waterfalls.

Questions:

1. How does carbon dioxide get into the soil?

2. What is produced when water mixes with carbon dioxide?

3. What is the term used for cave formations?

Observations:

	End of Day 1	Day 2
String		
Below Sag in String		

Results:

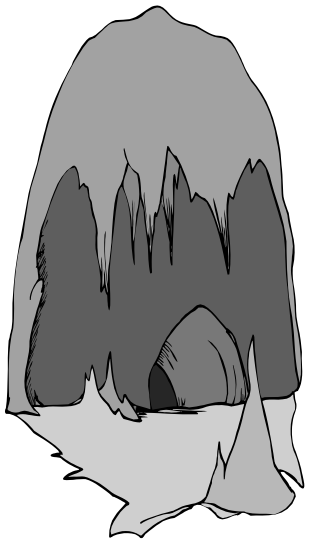
1. What do you see happening to the string?

2. What do you see happening below the sag in the string?

Conclusions:

1. How is this experiment similar to the way speleothems form in caves?

2. How is this experiment different from the way speleothems form in caves?



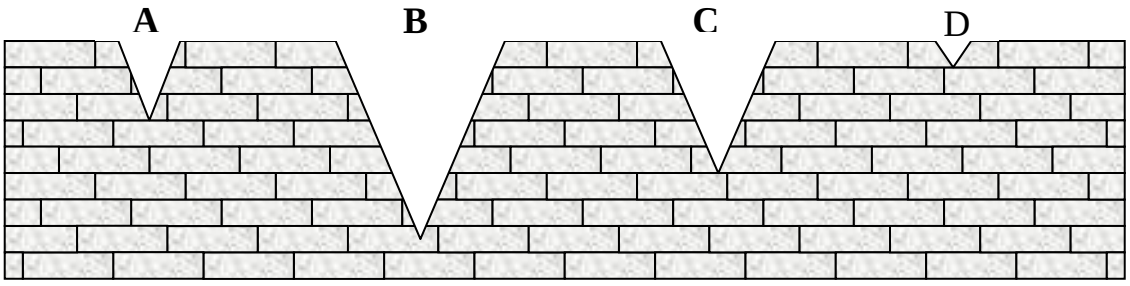
SOLUTION ACTIVITY

THE CREATION OF CARLSBAD CAVERNS NATIONAL PARK

The creation of Carlsbad Cavern began 250 million years ago with the formation of a 400-mile-long reef in an inland sea that covered this region. 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 after mixing with carbon dioxide in the air and soil, seeped down into the cracks in the reef. The water slowly dissolved the limestone and began the process that would form large underground chambers.

In this activity the dissolution of limestone will be simulated to help you understand cave forming process.

A block of limestone 26 mm thick was set up in a laboratory underneath a container of dilute carbonic acid. The carbonic acid was allowed to drip onto the limestone block in four locations (A, B, C, and D) which slowly dissolved the block to form small pits. At each location, the solution was allowed to drip for varying periods of time so that each pit is a different size.



The following table showed the measurements for the maximum depth of each pit in millimeters (mm).

Location	Time Period of Dripping	Maximum Depth of Pit (mm)
A	28 days	7 mm
B	68 days	18 mm
C	44 days	11 mm
D	12 days	2.5 mm

1. Using the graph paper on page 8, plot the depth of the pit (y-axis) against the number of days (x-axis).

   Make your **x-axis extend up to 120 days** and your **y-axis extend down to at least negative 10 mm**.

Data Interpretation:

1. Using your graph, how long would it take for a drip of acid to dissolve through 1 **cm** of limestone?

2. Using your graph, how many days would it take for a drip of the same acid to dissolve a pit through the entire block of limestone?

3. Follow the steps below to double-check your answer for Question #2.

   Use the following equations:

   Equation for a straight line: $y = mx+b$; "b" = y intercept (0, b)

   Slope: $m = (y_2 - y_1)/(x_2 - x_1)$

   Step 1: Calculate the slope of the line

   Step 2: Calculate "b" using a known location point from the graph.

Step 3: Calculate the time it would take for the block of limestone to be dissolved by the carbonic acid solution.

Did your answer using the graph match your answer using mathematical equations? (Circle one)

YES NO

Conclusion

1. What could you change in this experiment to increase the rate at which limestone is dissolved?

2. What natural changes in the environment could occur that would increase the rate of limestone dissolution?