

Post-Visit Activity #1

Sinkholes in a Cup

Overview	Students will demonstrate how sinkholes are formed. They will then show how these sinkholes can be closed up over time, and speculate how sinkholes can change the history of caves.
Objectives	Students will simulate the creation and destruction of sinkholes through the processes of weathering, erosion, and deposition.
Subjects	Science Language Arts Teamwork

(4.7) Earth and space. The student knows that Earth consists of useful resources and its surface is constantly changing. The student is expected to:

- B. observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

Materials for each group of 3-4 students:

16 oz. Styrofoam cup	Sand (2 colors)
Coffee filter or very thin sponge	16 oz. plastic bottle
One sheet of paper	Cup/pitcher to trickle water with
Container at least as tall as the cup	Wide container to catch water in
Sugar	

Background

Sinkholes are formed when a room of a cavern gets large enough that the ceiling can no longer support the weight of the rock above it. The weakened limestone causes the roof to collapse, leaving a void in the earth, or sinkhole. Sinkholes and landslides are both caused by water, but in very different ways. The physical force of water on debris, or erosion, can cause large amounts of soil to be moved from one location to another. This is a landslide. Sinkholes are caused by the chemical reaction of carbonic acid (water and carbon dioxide) with limestone (the process that forms solution caves). If a sinkhole is not immediately filled by the debris from the roof as it collapses, it can serve as an entrance to the cave. Eventually, wind and water erosion will push soil down into the hole enough to seal it off from the surface completely. In a cave like Inner Space, these sinkholes serve as windows that allow us to gather evidence about the time when they served as access points to the surface. Paleontologists can

determine, via carbon dating, the age of fossils found within the debris cone (pile of dirt) of a sinkhole and use those fossils to hypothesize about life on the surface during that time. There are debris cones for five known sinkholes inside Inner Space Cavern, the most recent of which sealed off about 14,000 years ago.

Getting Ready

You can cut the tops off of two liter soda bottles or milk jugs to serve as your large containers. You will need to cut a hole roughly 2 inches by 3 inches in the side of each 16 oz. bottle near the base. These bottles will hold the sand for the erosion portion of this activity.

The Creation of Sinkholes

Doing the Activity

1. Make a hole in the bottom of the cup about the size of a quarter.
2. Cut a circle the size of the bottom of the cup from the coffee filter/sponge. Place in the bottom of the cup.
3. Roll the paper into a tube with a diameter roughly half that of the cup, and tape together. Place the tube into the bottom center of the cup.
4. Fill the inside of the tube with sugar and the area around the tube with sand. Remove the paper tube. Sprinkle a thin layer of sand over the sugar.
5. Fill your tall container about half-full with water. This symbolizes groundwater. Place your sand/sugar cup upright in the water. The surface of the water should be roughly level with the top of your sand.

Expected Results:

It will not take long for the water to dissolve the sugar and for the top layer of sand to sink down into the void left behind. In this scenario, the sugar represents limestone, the sand represents other rocks and soils, and the water represents acidic ground water. When the water dissolves away enough sugar to weaken the structure of the “ground”, the sand on top will collapse under its own weight.

Supplemental

Explain to your students that eventually the water table will lower to a level beneath that of the cave. Lifting the cup from the water demonstrates what happens when the water level sinks. What happens to the sinkhole when the cup is removed from the water? Another option is to use a spray bottle pump to demonstrate a well drawing water and lowering the water table. Observe how the sinkhole changes as the water level slowly sinks.

The Destruction of Sinkholes

Doing the Activity

1. Have one student from each group hold the 16 oz. bottle horizontally while another fills it evenly with the second color of sand.
2. Take the cap off and make sure the student holding the bottle keeps the mouth over the sinkhole that has just been created. Another student will slowly pour water into the 2 X 3 inch hole on the side of the bottle. (The cup with the sinkhole should be sitting in the wide container. Water will still flow out of the bottom.)

Expected Results

The reason for using different colors of sand is to make it easier for your students to see and understand that the material filling the sinkhole is coming from a different source than that of the material involved in the collapse. The material from the surface (the sand from the bottle) will fill the void left by the sugar. This simulation shows that the formation of sinkholes is sudden and violent, while the closing off of one often takes time under the right conditions.

Assessment

Have your students write a short story on how sinkholes affect caves or about the development of a sinkhole. It can be from the point of view of an animal living in the cave, or the cave itself. They can write about the event of the roof collapsing, or how the hole filled in slowly over time. If there had never been any sinkholes in Inner Space, we would not have found any animal fossils. If just one of the sinkholes had remained open to the surface until present day, humans would have known about the cave a lot sooner. This would not necessarily have been a good thing. Inner Space is incredibly well preserved because there was no human interference until 1963. (Longhorn Cavern was used as a shelter for prehistoric peoples, as well as a mine for bat guano! The presence of humans in the cave before there were strict rules on cave preservation has resulted in rooms inside Longhorn being defaced and damaged.)

Bonus!

Remember Scalloped Ceiling Room? This room's main distinguishing feature exists because of the adjacent sinkhole. The acidic water that created the void of the cave was, for the most part, horizontally stationary. (Over time, it did seep down into the rock beneath it.) Often the sinkhole served as a conduit for rapidly flowing water to enter the cave. The force of the water against the ceiling broke down the rock, which eventually settled to the cave floor. The breakdown of the rock is mechanical weathering, while the movement of the material is an example of erosion. Thus, the carving of the wave pattern on the ceiling in this room was formed by two physical processes.