

LEARNING ABOUT CAVES

Objectives:

Students will be introduced to the idea of caves and cave life.

Students will be able to define what a cave is.

Students will be able to define a speleothem and list several that are commonly found in caves.

Students will be able to define troglomenes, troglomiles, and troglobites

Materials: A web connection to the videos:

- <http://news.discovery.com/videos/earth-the-skinny-on-cave-formations.html> a discussion of how caves and speleothems form.
- <http://www.nps.gov/wica/naturescience/cave-formations-speleothems.htm> pictures and discussion about the formations of Wind Cave National Park.
- <http://www.cavebiota.com/> is an excellent website on life in a cave. *The Levels of Cave Adaption* by Jean Krejca Ph.D. explains troglomiles, troglomenes, and troglobites. Hazel Barton Ph.D's Cave Microorganisms provides an excellent explanation of microbes found in caves.

Background:

Caves are dark, mysterious and packed with wonders to discover! A cave is defined as an opening in the earth large enough to hold a person. Most caves are created when slowly-moving water dissolves, or eats away at limestone rock, creating spaces, caverns, and tunnel-like passages. Wind Cave began developing millions of years ago, but most of the cave forming activity was pretty slow until the uplift of the Black Hills which occurred between about 60 million years ago. This uplift created fractures in the limestone allowing water to enter the rock and the cave to form. The waters that made Wind Cave probably sat in the limestone for long periods of time. Water did not flow through the cave like a river. Because the water sat in the cave, it had plenty of time to dissolve passageways along the many small cracks, developing the complex maze-like pattern that you can see on the cave map.

Wind cave is quite different from other caves. Instead of stalactites and stalagmites, the cave is decorated with boxwork. Boxwork is a crystalline formation that probably predates the cave. It was formed when calcite filled tiny cracks within the limestone. Later, when the cave formed, water dissolved the limestone and revealed the delicate crystal fins that had filled the cracks. Wind cave is known for its length and the maze-like configuration of its passageways. Almost all of the known cave passageways lie beneath a land area of about one mile square making this the most complex maze cave in the world. Few caves are longer than Wind Cave, but none as complex.

Cave Formations or Speleothems:

Caves are home to many interesting features or speleothems. Wind Cave is known for a unique formation called boxwork. In other caves the most common speleothems are stalactites and stalagmites. They form when water drips into the cave leaving behind a little bit of calcite. As each drop falls, more calcite is left behind creating stalactites, stalagmites, flowstone, and/or dripstone. When the water drips from the cave ceiling a stalactite begins to grow. While stalactites grow from the ceiling,

stalagmites are formations that grow up from the ground. When they meet, they form a cave column. In Wind Cave these types of water formations are rare.

Cave Life:

Caves are found deep in the earth and are worlds without sunlight. Without sunlight, plants can't grow. So food is carried into caves by either streams or small openings that let organic material wash into it. Wind Cave does not have a river or stream in it so food in is pretty scarce. Therefore life beyond the entrance of the cave is limited to very small organisms such as mites and springtails. Below is a list of the types of life one might find in a cave.

- **Trogloxenes** – are casual visitors. They will visit a cave for a short period of time but they have to leave the cave to complete their life cycle. Bats are the creatures most people associate with caves. Wind Cave National Park hosts eight species of bats, six of which are cave-dwelling however they are not commonly seen in Wind Cave. Bats are troglaxenes because they must leave the cave to feed.
- **Troglophiles** can spend their whole life in a cave, but they don't need to - these same species can also survive on the surface. Wind Cave has a few salamanders and spiders that spend their life in the cave.
- **Troglobite** are fully adapted to live in a cave. They spend their whole life cycle in a cave. They are so adapted to the cave environment that they can only survive underground. Many do not have eyes or pigment in their skin. In Wind Cave these are the springtails and mites that are found in the far reaches of the cave.

While Wind Cave is one of the longest caves in the world other caves equally as amazing can be very small. Caves can take tens of thousands, or even millions, of years to form, which means we have to work hard to protect them.

Procedures:

1. Before showing the videos, ask the students what they think makes a cave; what they would find in a cave; and what might live in a cave.
2. The short Discovery video discusses the origin of caves and explains how water combines with carbon dioxide to form carbonic acid, which dissolves limestone caves. It quickly discusses the origin of less common caves such as lava tubes, sandstone caves, sea caves, and ice caves. The relationships between groundwater flow and cave formation are discussed along with a discussion of speleothems (formations) and the processes under which they form. The processes are discussed rather quickly, and students may not easily understand them, but the names of the formations are told well. The fragile nature of cave formations is also talked about.
3. After showing the video, compare the opinions of the students with what they learned through the video.

Discussion:

When showing this video to students, discuss the following topics.

- Discuss the processes of the formation of speleothems to make sure it is understood. Emphasize the process of water dripping, flowing, and seeping, while leaving calcite behind through degassing and evaporation. The basic process of the formation of stalactites and stalagmites happens when water traveling from the surface picks up carbon dioxide from the plants and/or soil. This causes the water to become acidic (carbonic acid). This acid has the power to dissolve limestone (calcite is the basis of limestone) and carry it in solution. When the carbonic acid (water) enters an air filled chamber (cave), the carbon dioxide degasses (leaves) from the water (the carbon dioxide goes back into the air). This results in the pH level of the water changing. The water can no longer hold the limestone (calcite) in solution. So it leaves small particles (crystals) of it on the wall of the cave. If the water is dripping it will create a stalactite. If the water doesn't lose the carbon dioxide until it hits the floor of the cave, it will create a stalagmite. Most other speleothems are formed in some variation of this process. In Wind Cave this process creates popcorn and frostwork as well as the rare (for Wind Cave) stalactites, stalagmites, and flowstone. For more information about how speleothems form, explore Carol Hill's book *Cave Minerals of the World*.
- Discuss the impact on caves caused by various uses (i.e. mining cave minerals, health care, public tours, etc.). How could these impacts be avoided?
 - As people visit the cave they leave behind skin cells, hair, lint from their clothing, as well as oils from their skin if they touch the cave. These can all change the way water acts in the cave – how could that damage formations or cause them to cease forming.
 - Lights in a cave can provide enough light energy for plants to grow and raise the temperature in the cave – what would that do to the formations?
 - Because the boxwork in Wind Cave is older than the cave it will never form again – what would removing it mean?
- The draperies seen on the Luray Cave "organ" were filed down to make the various musical notes that can be played on the organ. How might this affect the formations?
- What would changes in the cave do to the animals living there? Have the students investigate white-nose syndrome and its impact on our country's bat population. How will that impact us?