Nature's Wonders: Caves

Welcome to the first installment of the "Nature's Wonders" series. This week, we explore how caves are made and some of the cool sights that are exclusive to caves.

PRACTICAL SCIENCE WITH PHIL FREDA

What is a cave?

The simplest definition of a cave, according to whyzz.com, is an opening in the earth that is large enough to hold a person.
Some of the most spectacular caves however, are gigantic underground systems that may be miles long.
Caves usually take on the order of thousands, sometimes millions, of years to form.

Scientists who study caves, and all aspects of the internal and surrounding environments, are called speleologists.

Exploring a cave for recreational reasons is mainly called "caving," but another popular term for the act of exploring a cave is called "Spelunking."

How are caves formed?

According to PBS's Nova website, there are four main natural forces that can cause caves to be formed:
Rainwater

Caves made of limestone are the most numerous types of caves found throughout the world.

For the majority of limestone caves, the falling and accumulation of rainwater, over large tracts of time, is responsible for their formation.

Limestone formations were formed millions of years ago and are mostly comprised of the remains of long dead marine life. Most limestone formations were originally formed in shallow seas, but because of plate tectonics, some limestone formations are now on dry land.
Limestone, which is a form of sedimentary rock, forms large, solid, rectangular blocks.

After falling to the ground, the rainwater seeps into the soil. Small amounts of carbon dioxide (CO_2) from the atmosphere are already dissolved in the rainwater itself.
As the rainwater continues through the soil layers, it picks up lots more CO_2 because of large amounts of decaying organic matter (dead animals and plants).

A chemical reaction occurs between the water and carbon dioxide forming carbonic acid (H_2CO_3).

The carbonic acid continues to seep through the soil and limestone until reaching the water table, which is the level at which rock, soil, or other material becomes saturated with the ground water.

After reaching the water line, the carbonic acid, which is corrosive, gets to work and slowly eats away at the limestone directly below the water table.

This action eventually forms channels and if the channel is large, the more water it can hold. More water means the faster the reaction will occur, resulting in a higher rate at which the limestone dissolves.

These formed channels may develop along the water table or extend down along fissures within the limestone.

This process takes millions of years to occur.

Additionally, water in the cave moving at high rates of speed can cause carving and hollowing of the cave, making it bigger.

This process is similar to how the Colorado River shaped the Grand Canyon.

Waves

Waves constantly crashed at the base of a cliff can cause a sea cave to be formed through erosion(the slow, methodical removal of sand or rock due to constant water moving across the surface).
This constant pummeling of the base of the cliff face by the water causes it to be carved out, forming an overhang.

Sea caves are usually formed in sandstone but can also occur in other types of sedimentary rock, even limestone.

Lava

Lava is super hot molten (plastic or liquid) rock that has reached the Earth's surface through volcanic activity. Lava forms caves within a lava flow it is traveling in, instead of eating away old, existing rock.

This movement of lava forms a tongue-shaped channel in which it moves faster than the fast cooling lava around it.

This is akin to how there are currents within a stream or river that move faster than the water surrounding it.

The slower-moving lava along the sides of the lava flow start to cool first, then a crust forms on top of the lava flow as that begins to cool.

This action encases the lava flow within, trapping heat and allowing the lava flow to continue.

Eventually, the flow of lava will cease from the source that it is coming from. This leads to an empty, hollow tube or cave.

The molten rock eventually clogs at the end of the tube, forever sealing it. The entrances to these caves are usually found on the surface where a brittle portion of the ceiling has collapsed in.

Also, future lava flows can bury the cave deeper and deeper.

The longest known lava cave in located is the Kazumura Cave located in Hawaii that is 30-miles long.

Bacteria

That's right!

These little guys can do some seriously damage over long tracts of time.

Some bacteria have the ability to metabolize and break down oil deposits.

Most of these bacteria may not be bacteria at all, but belong to the Archaea.
The Archaea are prokaryotes like bacteria, but usually live in extreme environments or perform extreme feats, like feeding off of oil.
A byproduct of this metabolism is sulfide gas (H_2S) which mixes with oxygen to form sulfuric acid (H_2SO_4).

This is an extremely strong acid which eats away at the limestone rock. A byproduct of this corrosive reaction leads to the formation of gypsum, a very short, translucent mineral.
Other bacteria or Archaea can use the hydrogen sulfide cause to produce more sulfuric acid and eat away at the cave even faster.

Some of these prokaryotes can even feed on minerals within the rock like sulfur and manganese, further accelerating the cave-eating process.

Cave Terms

- **Stalactites**: The constant flowing of water through cracks in the cave ceiling causes large spike shaped formations that travel downward from the ceiling through a chemical process. They are made of calcium carbonate (limestone).

- **Stalagmites**: As the water drips from the stalactites on to the cave floor, the reaction can happen again, but in this example, it builds a spike formation from the ground up to the ceiling. When stalagmites and stalactites meet they form a cave column. If you are having trouble remembering which is which, just remember that a stalactites holds **tight** to the ceiling and a stalagmite **might** make it to the top one day.

- In addition to stalactites and stalagmites, which make up the majority of cave formations, caves also form crystals, flowstones, and many other smaller formations.

Thank you for taking time out of your busy day to explore caves with me. I hope you enjoyed it.

If you would like to visit a cave soon, visit the National Caves Association website to find one near you.
If you are interesting in exploring cave wildlife, click this link provided by the Kent Undergrounds Research Group.
Also, if you would like, take Nova's interactive tour on caves!
Also, click on the link to see a list of some of the world's record breaking caves!

Here is a list of some caves in the PA area:

- Crystal Cave Park
- Indian Caverns
- Indian Echo Caverns
- Laurel Caverns
- Lincoln Caverns
- Lost River Caverns
- Penn's Cave
- Woodward Cave