

## Intro to Missouri Caves

- Missouri has so many caves that it has been nicknamed “The Cave State”
  - Do you have any idea how many caves we have in Missouri?
    - 6,800 have been found so far!
  - About 100 new caves are discovered in this state each year
  - They exist in 74 of our 114 counties
    - Most of them are in the Ozarks (in the southern half of the state)
    - The most caves found in any one of our counties is 650!
      - (Perry County)
  - Crevice Cave is the longest in the state, extending over 28 miles

So, where did all of these caves come from?

- Much of Missouri, including this location, was once covered by a shallow, ancient sea
  - The oldest cavernous rocks were deposited by this sea 500 million years ago during the Cambrian Period
- This area’s caves, as well those around Springfield and Columbia, Missouri, were formed from limestones deposited 350 million years ago during the Mississippian Period
  - **Limestone** is formed when shells and bones of marine animals pile up on the sea floor
    - They contain the mineral **calcite** (also called *calcium carbonate*)
    - Over time, pressure compresses and hardens these remains together as a layer of limestone
- The limestone in Missouri eventually built up to about 1500 feet thick
- Forces from inside the earth pushed up on the sea bottom, cracking the rock layers, like when a baseball hits a window and cracks the glass
  - These cracks are called **joints**
    - They are the beginning of caves

## Limestone Cave

- The mineral calcite that makes up limestone can be dissolved by most acids, and this process of solution is what forms limestone caves, or **solution caves**
  - They are the most common type of cave
  - Dolomite is another easily dissolved mineral that many solution caves develop in
  - These caves take a very long time to form; thousands of years in fact
    - Mark Twain Cave is believed to be about 150 million years old
- The process starts with rain
  - When rain falls to the earth, it picks up carbon dioxide in the air

- As rainwater trickles through the soil, it collects even more carbon dioxide from decaying plants
  - The mix of carbon dioxide and water forms a weak solution called *carbonic acid*
  - This is the same acid that makes fizz in a soda!
- Carbonic acid travels down through the ground until it reaches limestone or dolomite
  - it begins to dissolve holes in the soft rock and makes its way into any joints
  - the holes and joints become bigger and bigger, filling up with more and more acidic water
  - underground streams may form, eroding away more rock as carbonic acid continues to eat away larger and larger spaces in the stone
- This is how cave passages and rooms form
- When water drains away, from climate change or the land rising, air enters the hollow space
  - a cave remains

### **Differences in Caves**

- Caves vary in temperature & moisture. Different caves can be:
    - cold & wet
    - cold & dry
    - warm & wet
    - or warm & dry

Missouri caves have an average temperature of 55-58° F

  - This means they are cooler than outside in the summertime & warmer than outside during the winter
- Nearly all Missouri caves are made by the solution method we discussed, most of them in Gasconade dolomite deposited 450 million years ago
- Other caves in the country and the world can be created by ocean waves, lava, or ice

### **Sea Caves**

- Sea caves are made by ocean waves pounding on seashore cliffs
  - rocks and sand in carried by the waves help to wear away the softer rock to form a cave

### **Lava Tubes**

- Lava that flows down the sides of volcanoes hardens on the surface but not below
  - When the lava underneath flows away, it leaves a cave behind, called a “lava tube”

### **Ice Caves**

- Ice caves may form under glaciers
  - This happens when ice on the surface melts
  - The water then trickles through cracks in the glaciers and collects into streams underneath, which eventually erode tunnels, making caves under the ice
- Some rock caves can even change into ice caves after becoming coated with ice
  
- A number of caves are mazes, like Mark Twain Cave

- maze caves had many joints, causing a web of passages to develop
- Other caves may contain large rooms, waterfalls, lakes, or pits, and many in Missouri have streams & pools
- Certain caves must be traveled through by boat!
- Caves also have all sorts of unique decorations called **speleothems**
  - Ever heard of a *stalactite* or *stalagmite*?
  - Well, this is how they form...

### Cave Formations

- After a cave fills with air, acidic water still seeps into the cave through cracks in the rock, carrying calcite that it dissolves on the way down
  - Each drop that enters the cave leaves behind some calcite
  - On the ceiling, calcite rings stack on top of each another, building a skinny hollow tube called a **soda straw** (that's exactly what it looks like)
    - More droplets may make the straws thicker, forming a **stalactite** (looks like a stone icicle)
  - Drops that fall to the cave floor may also leave calcite behind
    - This makes a **stalagmite** from the ground up
  - Stalactites hang *tight* to the ceiling, and stalagmites *might* reach them one day
    - If a stalagmite reaches a stalactite, a **column** forms from the floor to the ceiling
- Stalactites, stalagmites, and columns are all **dripstone** because they're made by dripping water
  - Other fascinating speleothems include flowstone, rimstone, cave pearls, gypsum flowers, cave corals, and curtains
- You may even see different colors in these structures caused by other minerals that got mixed into the solution
- Cave formations are so delicate that even oils from your finger tips can damage them

### Biology of a Cave

- Many living organisms use caves
  - Missouri caves alone shelter 900 species of wildlife
- All life, including cave life, depends on the sun
  - Green plants use sunlight to produce the energy they need
    - They are at the bottom of the food pyramid, and all other living things rely on them for energy
- So how does a cave support life without light?
  - By food brought in from outside
    - plant & animal debris washed in by seasonal flooding
    - remains of animal visitors who entered & died
    - animal droppings rich in organic nutrients
      - All form the base of the food pyramid in a cave
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- Bat guano (droppings) provides a major source of nutrients for decomposers (like bacteria, fungi, beetles, and worms)
  - Therefore, caves with high bat populations have higher numbers of other cave animals
  - Caves with much litter & twigs blowing in entrances or flushing through cracks in the cave ceiling also have higher populations of cave organisms
- The base of the cave food pyramid is much smaller than the base of the outside world's food pyramid
  - Therefore the entire pyramid is smaller
  - The smaller the pyramid, the more easily it can be disturbed or destroyed
  - Cave life only survives with a carefully maintained balance
  - People should take care not to bother the cave's inhabitants
- Not all caves contain life
- Not all parts of a living cave contain the same kinds life

## Cave Zones

### Entrance

- At the entrance, cool, moist air can be felt drifting out
- This is the only part of a cave that receives direct sunlight
  - Because of this, there is more life here than in any other part of the cave
- Some birds (like the Eastern phoebe), nest at the mouth of the cave, but never deeper
  - Vultures often raise young at this spot
- Snakes may rest here in the summer to cool down their body temperature
- The mouth of the cave may also contain woodland plants
- Leaf litter & organic debris that has blown into the cave accumulates at the entrance
  - Decomposers come to feed on this, such as:
    - millipedes, centipedes, roly-polies, snails, earthworms, & insects
- Salamanders that use caves but aren't limited to them may be found here
  - E.g. cave salamander may also live under logs & leaf litter in the forest
    - Animals that can live in caves OR outside of caves are called **troglophiles** (means "cave lovers")
      - They are usually found near the entrance where some light filters in
      - Trogllophiles may move back and forth from the outside to the inside as they search for food
        - ◆ Besides salamanders, many insects or fish that swim upstream into caves are trogllophiles
    - Some flying insects, such as fungus gnats, flies, & midges (look like mosquitoes) may rest on cave walls
      - But these aren't restricted to entrance zone

- They may move deeper into the cave in winter months

### Twilight zone

- Immediately after the entrance, we enter the twilight zone where light quickly begins to disappear
- This zone stretches from the cave entrance to as far as daylight can be seen inside
- All light past the entrance is reflected; only the mouth has direct sun rays
- This area is damp and cool with a lot of change in temperature and humidity
  - Snakes, skunks, or mice may live here
  - Few plants can grow in the cool air and low light, but mosses and walking ferns can
    - Some people used to live here thousands of years ago
- it gave them protection from weather & dangerous animals
- Bits of charcoal, stone knives, broken pottery pieces, & animal bones have been found in the twilight zone

Next, we have 2 dark zones: the variable temperature zone and the constant temperature zone

### Variable temperature zone

- The variable temperature zone has total darkness, but humidity and temperature still change here daily and seasonally, just not as much as the twilight zone and entrance
  - No green plants can exist here in the absence of light
    - However, mushrooms, mold, & other fungi do grow in this zone
    - Bats roost here during their active months
      - Bats are part of a group of cave inhabitants that spend a lot of time in caves but cannot complete their life cycle inside
  - They are called **trogloxenes**, which means “cave guests”
    - They may use caves for shelter but then leave them to find food
    - Or they might hibernate in caves
      - This includes a wide variety of animals, such as bears, bats, and certain moths and frogs
      - Skulls of saber-toothed tigers or ancient giant lions have even been found in Missouri caves

### Constant temperature zone

- The deepest part of cave is the constant temperature zone
  - It is absolutely pitch-black, and air & water here are the same stable temperature year-round
    - The air is still, and it may smell moldy
    - Most everything is moist
  - Some bacteria & molds grow in this zone
- This is where the true cave dwellers live
  - These creatures are called **troglobites**
    - They spend their entire lives in caves, and cannot survive outside of them

- Troglobites live permanently in the dark zones but they are adapted to living without light
  - They are blind and white or pink in color
    - there is no need for eyes in the total darkness or for skin pigment where sun's rays cannot harm them
  - Their other senses are stronger to make up for their lack of eyes
    - They must rely on touch, sound, & taste to find food
    - Longer legs & antennae are additional adaptations to help them feel their way around
  - Troglobites can go longer periods of time with little food, which is necessary for survival deep in a cave
    - Examples of these white, blind creatures are cave fish, millipedes, and cave crayfish
  - Troglobites make up over 80 of the 900 species of wildlife sheltered by Missouri caves

### Uses for caves

- Since prehistoric times, caves have been used as homes, burial grounds, and religious sites
  - And as a source for water, clay, flint, & minerals
- Ancient paintings & drawings have been discovered all throughout some caves
  - This art in addition to artifacts found demonstrate the use of caves over 10,000 years ago
- Native Americans used hundreds of caves in Missouri
  - The darkest parts of caves were believed to be where the gods & spirits lived
  - Medicine men & chiefs held ceremonies here
- In the 1700s, people began mining for bat guano, which they used to make gunpowder
- By the 1800s, caves were used as taverns, barns, spring houses, beer and wine cellars, and as a meeting place for social gatherings, political events, and religious services
- Settlers used spring-fed cave streams to power their mills for paper, wool, sawing, and grinding grain
- Today, caves are used as sources for drinking water, as sites of scientific discovery, as places of exploration for cavers, and as tourist attractions
  - **Speleology** is the scientific study of the cave environment
    - A **speleologist** is an expert who study caves
  - **Spunkers**, better known as **cavers** are people who explore caves
  - Water usually receives some purification, or cleansing, by filtering through the ground into caves
    - Wells and springs used for our drinking water come from these ground sources, so it is important not to pollute the ground or water with wastes

## Threats to Caves and Cave Life

- The need for caves to be protected was not presented until the late 1950s
  - Conservationists realized that caves were important scientifically and historically
    - homes for rare and endangered species of wildlife, contain valuable archaeological sites, have unique and delicate formations, and are a natural resource for water
- The Missouri Cave Resources Act was passed in 1980 to ensure that caves are protected and preserved
- Even with laws, caves are still threatened by human activities
  - Pollution from improper disposal of wastes can contaminate groundwater systems which run through caves
    - People often dump harmful things into **sinkholes**, which is an opening in the ground to a cave that acts like a funnel, directing rainwater and debris into the cave
      - This harms the cave life that uses the water
      - Also can harm people who drink water that springs up from caves or comes from wells
    - In the U.S., 7 species of troglobites (permanent cave dwellers) we KNOW of have become extinct
      - 6 of them in the last 50 yrs
      - 30 of the 80 Missouri troglobites are endangered or threatened
        - ◆ Such as a cavenail that is only found in 1 cave
      - Their decline is caused by a lower quality of water
    - Conserving our groundwater properly will protect much of Missouri cave life
  - Vandalism, which is when people purposely cause damage caves, has also been a problem, even though there are laws against it
  - Making fires inside caves fouls the air and irritates the organisms inside
  - Leaving trash, food, batteries, or human waste can harm the fragile cave ecosystems

Cavers have a motto to help us remember how to treat a cave:

- *Take nothing but pictures*
- *Leave nothing but footprints*
- *Kill nothing but time*

Respect caves so that other people and animals may enjoy them for ages to come!

*RESOURCES*

*Rocks and Minerals* by Caroline Bingham

*Caves and Caverns* by Gail Gibbons

National Park Service

Missouri Department of Conservation

Missouri Department of Natural Resources

Mark Twain Cave website

[mocavesandkarst.org](http://mocavesandkarst.org)

*Rocks and Minerals* by Frederick H. Pough

National Speleological Society

Cave Conservancy of Virginia

Scholastic

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