

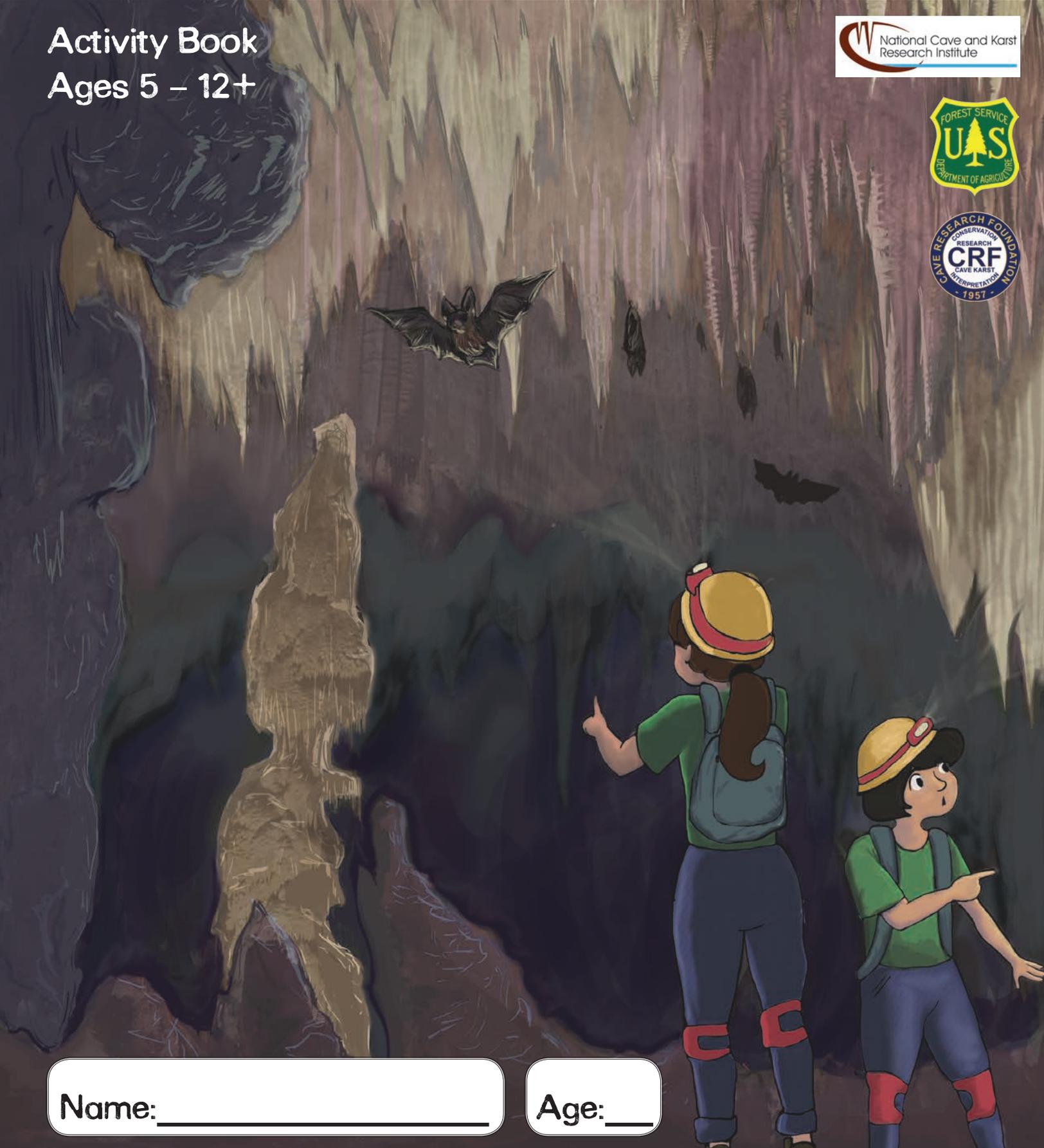
Junior Cave Scientist

National Park Service
U.S. Department of the Interior

Geologic Resources Division
Cave and Karst Program



Activity Book
Ages 5 - 12+



Name: _____

Age: _____

Explore • Learn • Protect

Become a Junior Cave Scientist

Caves and karst landscapes are found throughout the United States. These features are important as part of our Nation's geologic heritage.

In this book, you will explore a fascinating and fragile underground world, learn about the values of caves and karst landscapes, and complete fun educational activities.



Explore

magnificent and beautiful caves. You will find an amazing underground world just beneath your feet!

Learn

about caves and karst systems and the work that cave scientists do.

Protect

our natural environments and the things that make caves and karst areas special.



To earn your badge, complete at least _____ activities.
(Your Age)

Activities in this book are marked with an age indicator. Look for the symbols below:



Flashlight
Ages 5 - 7



Lantern
Ages 8 - 11



Helmet and Headlamp
Ages 12 and Older



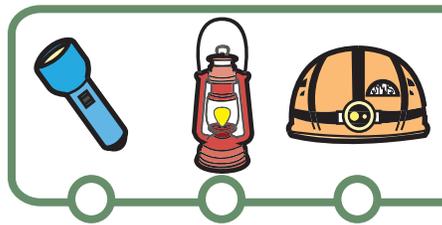
Put a check next to your age indicator on each page that you complete.

I received this book from: _____

After completing the activities, there are two ways to receive your Junior Cave Scientist badge:

- Return the completed book to a ranger at a participating park, or
- Visit go.nps.gov/jrcavesci

What are Caves and Karst?



Caves are naturally occurring voids, cavities, interconnected passageways, or alcoves in the earth. Caves preserve fossils, minerals, ecosystems, and records of past climates. Specially adapted animals live in extreme conditions within caves. Caves are beautiful to look at and provide great places to explore and learn.

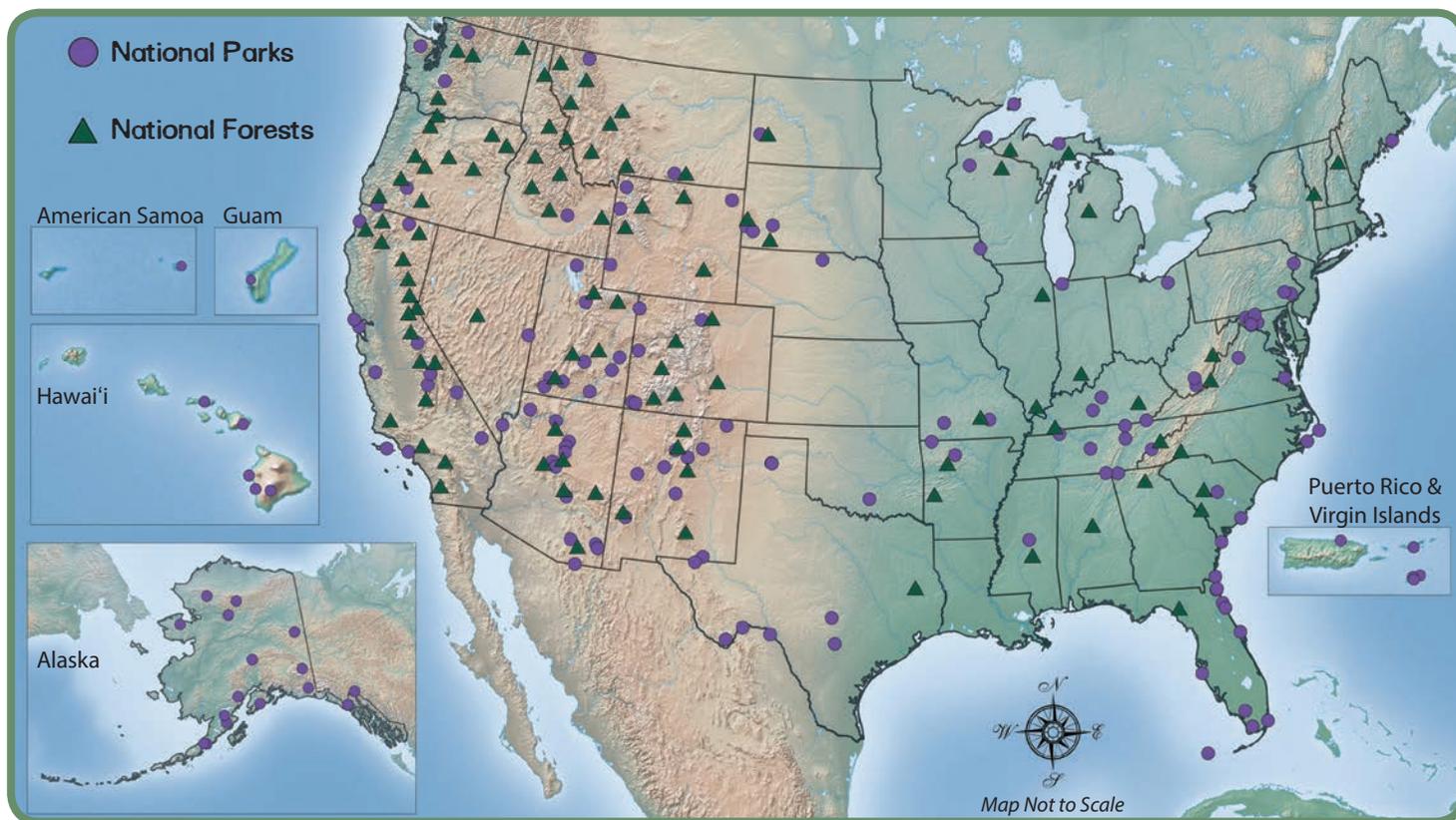
Karst is a type of landscape that forms when rocks are dissolved by weak acids. Acidic groundwater slowly dissolves the rock creating large passages and channels. Karst landscapes usually have caves, sinkholes, sinking streams, and springs.

Speleologists (spē-lē-ōl-ō-gists), also known as cave scientists, explore and map caves; and study animals, water, rocks, fossils, and other aspects of caves and karst systems.

Learn more about caves and karst systems at:
www.nature.nps.gov/geology/caves/index.cfm



Areas with Caves and/or Karst Features



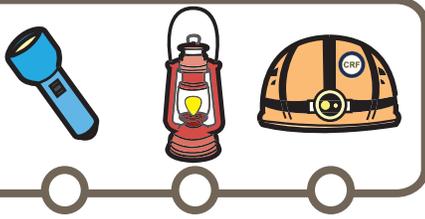
Put an **X** on the map where you live, or the area you are visiting.
 Are there any caves or karst features to visit in your state?

Yes

No

Be Cave Safe!

A Quick Guide for Cavers Big or Small



As a Junior Cave Scientist, it is your job to make sure that you are prepared and safe during your caving trip. Make sure to ask for permission before entering a cave. **Learn what to take and the "rules of three" to be cave safe.**

What Should You Take for a Safe Adventure?

Decide what items are necessary for a safe cave adventure but avoid carrying too much! **On this wild trip you can only bring 13 items. Which will you choose?**

- | | | |
|--|--|-------------------------------------|
| <input type="checkbox"/> Headlamp | <input type="checkbox"/> Helmet | <input type="checkbox"/> Trash bag |
| <input type="checkbox"/> Water bottle | <input type="checkbox"/> Umbrella | <input type="checkbox"/> Snacks |
| <input type="checkbox"/> Ice cream | <input type="checkbox"/> Flashlight | <input type="checkbox"/> Bicycle |
| <input type="checkbox"/> First aid kit | <input type="checkbox"/> Extra batteries | <input type="checkbox"/> Knee pads |
| <input type="checkbox"/> 2nd headlamp | <input type="checkbox"/> Sunglasses | <input type="checkbox"/> Gloves |
| <input type="checkbox"/> Map of the cave | <input type="checkbox"/> Elbow pads | <input type="checkbox"/> Basketball |



Never go into a cave without a responsible adult. Bring all of the appropriate gear and always travel with **at least a group of three**. To be cave safe, travel with someone who is familiar with the cave you are exploring.

Getting Ready to Leave

To make your cave adventure safe, be sure to always let **three people know where you are going**. **Who will you tell that you are going into a cave?**

1. _____
2. _____
3. _____

Three Sources of Light

When going into a cave, be sure to carry at least **three sources of reliable light**. Being cave safe will keep you from getting stuck in the dark!

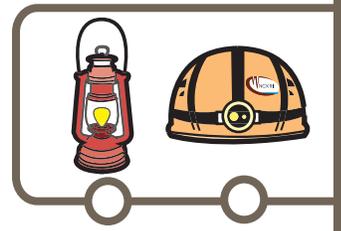


Now That You are Ready, What do You Hope to See in the Cave?

Do Not Overdo It!

Know your limit and do not over exert yourself. Always let the slowest caver set the pace of the group. Teamwork means helping each other, communicating frequently, and being aware of your surroundings. Save enough energy to make it out of the cave!

How to be a Careful Caver



Cave Etiquette

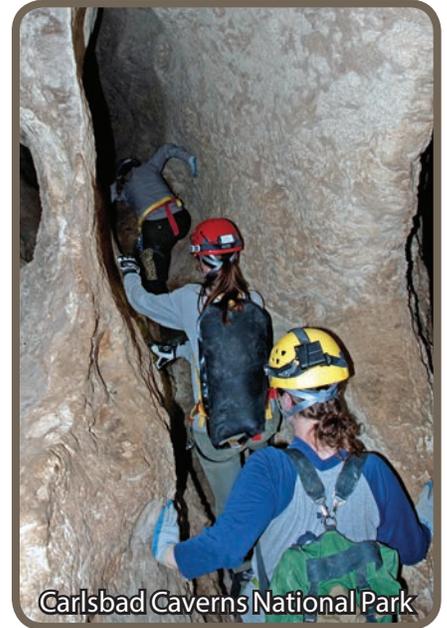
It is very important for Junior Cave Scientists to practice proper cave **etiquette**, or manners. This means that everybody has to do their part to take care of these special places. **Unscramble the phrases to learn how to be a careful caver.**

1. wildlife not do disturb

2. damaging features avoid cave

3. step careful be you where

4. in, it pack pack out it



Carlsbad Caverns National Park



Careful What You Touch!

Cave formations are fragile and the oils from your hands can cause discoloration and stop their growth.

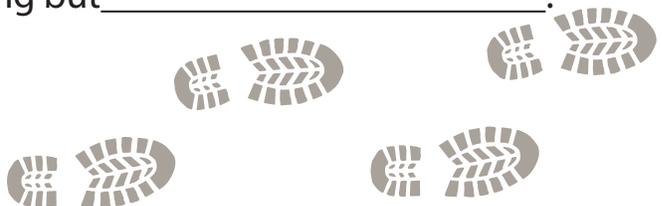


Wear clean gloves to protect your hands and the cave.

Challenge: Fill in the blanks for this well known conservation saying
Leave nothing but _____ footprints,
take nothing but _____, kill nothing but _____.

Word Bank:

pictures carefully time placed



Name That Cave



One of the topics **speleologists** study is **speleogenesis**—how caves form. **Use clues and pictures to help you choose the cave type.** Be careful, not all of the names in the word bank are real types of caves!

I form along rocky shorelines. The impact of waves creates me.



Apostle Islands National Lakeshore

I am a _____

I get my shape from molten lava. When the lava cools, my ceiling and walls are created. After the lava stops flowing, I become an empty tube.



El Malpais National Monument

I am a _____

I form when water dissolves bedrock. My walls are made of limestone, dolomite, marble, or gypsum. I am the most common type of cave.



Oregon Caves National Monument

I am a _____

I form between piles of rocks and debris from rockslides and rockfalls. I am found at the base of cliffs or steep slopes, and in narrow canyons.



Pinnacles National Park

I am a _____

Word Bank:

- Sea Cave
- Bat Cave
- Solution Cave
- Talus Cave
- Man Cave
- Volcanic Cave

Make Your Own Cave at Home

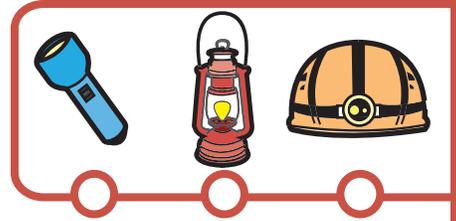
Making your own cave at home is really simple! Grab a few chairs and arrange them in a circle. Drape a sheet or blanket on top of all the chairs to form the cave. Be creative, how dark can you make the inside of your cave? Don't forget your flashlight!



Name Your Cave

Icing on the Cave

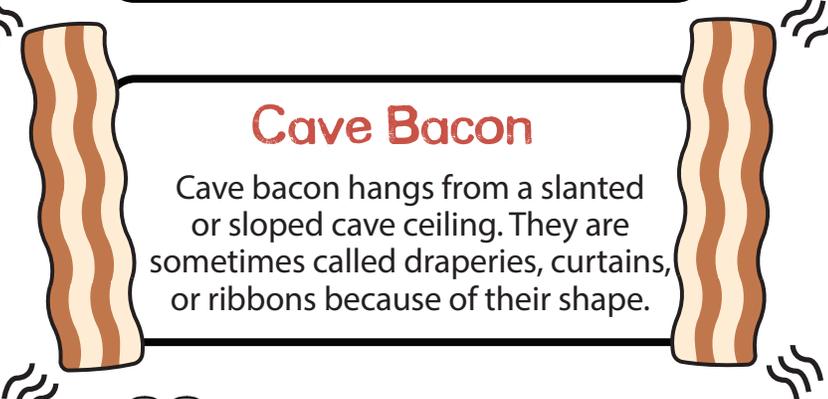
Cave decorations, also known as **speleothems**, are mineral deposits in caves. As water flows or drips into a cave, it leaves behind different minerals creating speleothems. **Draw a line from the speleothem description to its matching picture.**





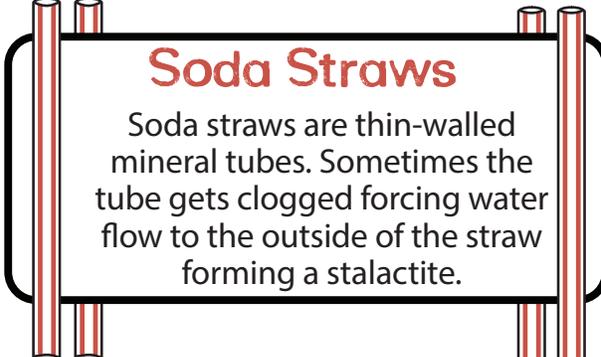
Cave Popcorn

Cave popcorn is a fun name for a type of speleothem formed as small balls of the minerals calcite, aragonite, or gypsum.



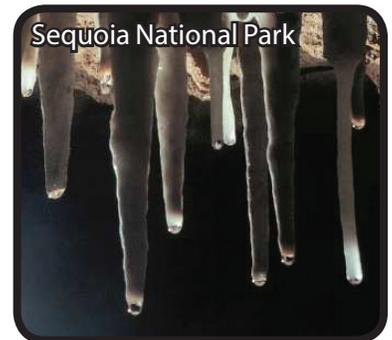
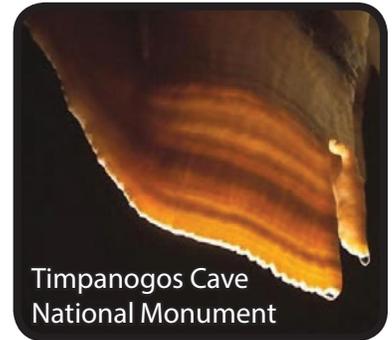
Cave Bacon

Cave bacon hangs from a slanted or sloped cave ceiling. They are sometimes called draperies, curtains, or ribbons because of their shape.



Soda Straws

Soda straws are thin-walled mineral tubes. Sometimes the tube gets clogged forcing water flow to the outside of the straw forming a stalactite.



Speleothem Math

Stalactites

Form from dripping water and hang on "tight" to the cave ceiling.



Stalagmites

Form where dripping water hits the floor. They "might" reach the ceiling someday.



Draw a Cave Column

Columns form when stalagmites and stalactites connect floor to ceiling.

Troglofauna Trio



Troglofauna refers to animals that live in a cave. Many animals that live in caves have special adaptations to their dark surroundings. **Find all of the underlined words in the word search.**

Trogloxene: The Cave Guest

Trogloxene comes from the Greek words *troglo* (cave) and *xenos* (guest). These guests spend much of their time outside returning to the cave for **shelter**, hibernation, or roosting. They usually leave the cave in search of **food**. Examples include bats, cave salamanders, birds, and pack rats.



Timpanogos Cave National Monument



Carlsbad Caverns National Park

Troglophile: The Cave Lover

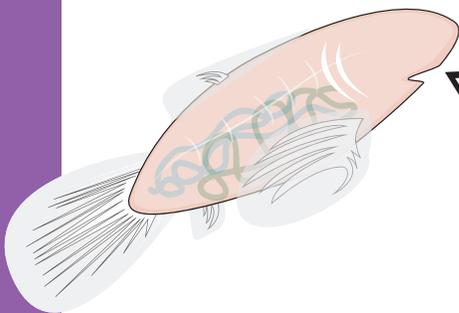
Troglophile comes from the Greek words *troglo* (cave) and *phileo* (love). These **cave** lovers can spend their whole life in the cave but can also live above ground. Some troglophiles have special adaptations, or **traits**, for living in caves. Examples include beetles, earthworms, and cave crickets.



Hays County, Texas

Troglobite: The Cave Local

Troglobite comes from the Greek words *troglo* (cave) and *bios* (life). These animals spend their entire life inside the cave. They are specially **adapted** to survive in extreme environments. Most of these animals lack color **pigment** and have small or no eyes! Examples include cave crayfish, blind cave fish, cave millipedes, and blind salamanders.

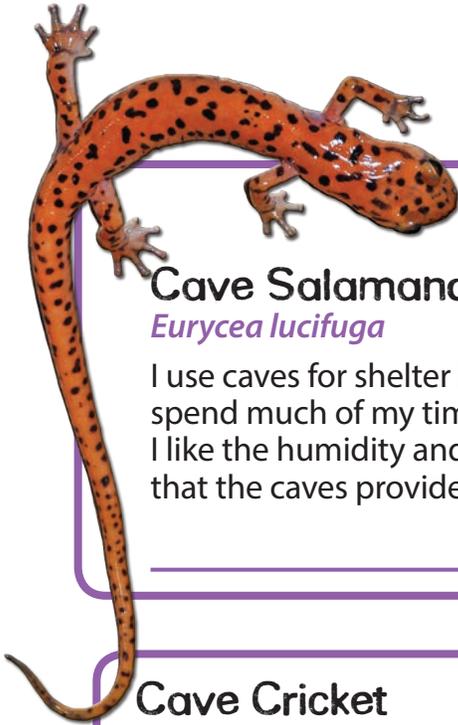


What troglofauna type would you like to be? Why?

N	G	O	Z	O	Q	G	T	P	T	D
P	I	G	M	E	N	T	R	R	Z	E
E	T	I	B	O	L	G	O	R	T	T
A	M	I	L	R	C	G	G	F	U	P
R	P	O	A	G	L	S	L	O	Z	A
R	E	Y	E	O	J	L	O	O	A	D
C	R	T	X	S	E	W	P	D	R	A
S	A	E	L	P	L	H	H	Z	T	P
M	N	V	R	E	V	J	I	M	Z	B
E	T	G	E	B	H	E	L	B	P	N
S	T	I	A	R	T	S	E	R	R	N

Reveal the Mysteries of THE CAVE DWELLERS

Mysterious animals live inside caves! **Identify which troglofauna category each dweller belongs to.** Use the previous page for help if you get stuck. **Draw a star ★ next to your favorite cave dweller.**



Cave Salamander

Eurycea lucifuga

I use caves for shelter but I spend much of my time outside. I like the humidity and safety that the caves provide.



Cave Millipede

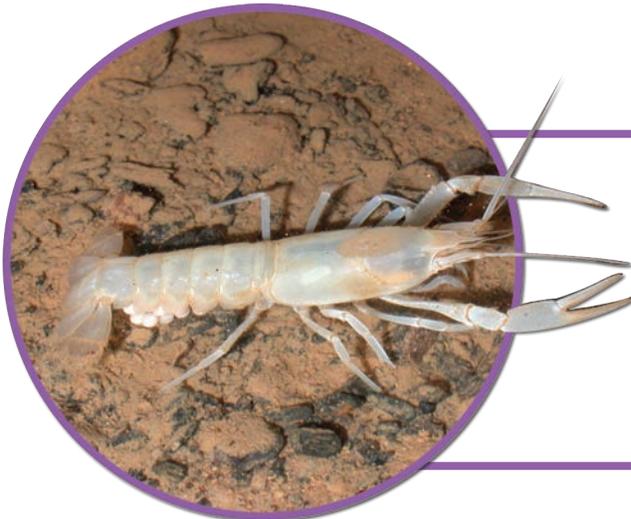
Trichopetalum whitei

I live deep inside caves. I have no eyes and have lost all of my pigment. I live completely in the dark all the time.

Cave Cricket

Hadenoeus subterraneus

I live throughout caves and usually leave them when it is time for dinner. I have very minimal adaptations for living in caves. If you go in a cave, you will most likely see me!



Cave Crayfish

Orconectes australis

I have no eyes, lack color pigment, and have other adaptations to live in total darkness. I mostly live underwater.

Cave Microbiology



Microscopic organisms (**microbes**) such as bacteria thrive in caves. Some microbes get energy from organic material brought into caves by animals or water. Others get energy from **carbon dioxide** and **nitrogen** from the air. Some even get energy from minerals in cave walls.

Snotty Snottites



Imagine seeing walls covered with snot-like film! **Snottites** are rare groups of sulfur-eating bacteria that hang from walls and ceilings of caves and have the consistency of snot. Snottites drip, just like your runny nose. They produce **sulfuric acid**, which can burn skin like battery acid! Snottites are very rare.

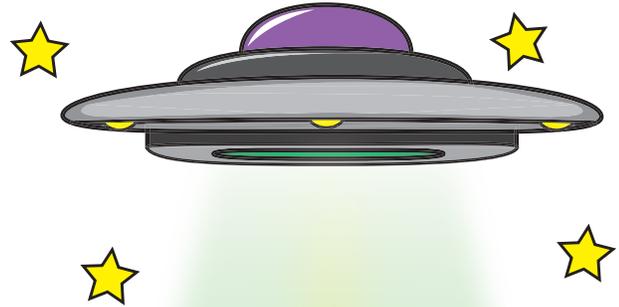
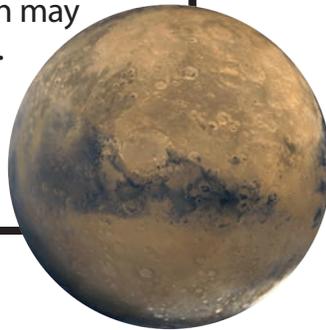
Medicine from Caves

Many cave microbes make compounds that one day could be used as medicine for people. These microbes may help scientists create antibiotics to fight drug-resistant "superbugs" and to understand how drug resistance in bacteria works. Caves have high potential for even more discoveries!

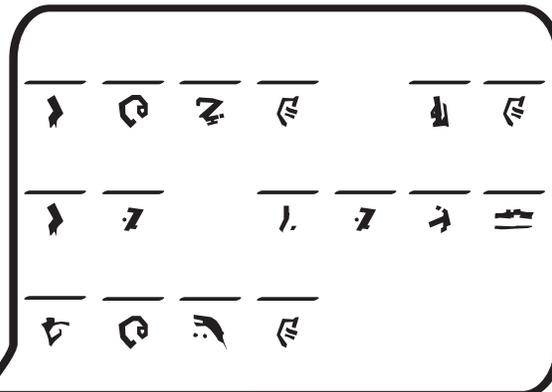


Life on Mars?

Cave scientists search for microbes in the extreme environments of caves. Like Earth, Mars has many caves which may have the potential to support life. The fact that microbes on Earth survive in extreme conditions suggests there could be life on Mars.



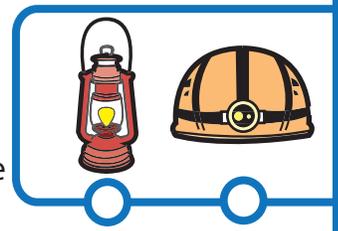
Decode the Secret Martian Message



A	⊙	N	⊙
B	⊙	O	z
C	↗	P	↗
D	⊙	Q	↗
E	⊙	R	≡
F	⊙	S	↗
G	↗	T	↗
H	z	U	↗
I	↗	V	↗
J	⊙	W	↗
K	z	X	↗
L	↗	Y	.
M	↓	Z	⊙

Flying Mammals

Bats are the only true flying mammals. There are 45 known species of bats in the United States. Many bats live in caves and mines. **Learn about four bat species and complete the activity at the bottom of the page.**



Spelao-Fact: Currently, there are 12 bats listed as threatened or endangered in the United States and its territories.

Mexican Free-tailed Bat

Tadarida brasiliensis

Habitat: We live in caves, mines, under bridges, and in buildings. We migrate to Central America during the winter months.

Eats: moths, beetles, flies, wasps, ants

The official state bat of Texas and Oklahoma!



Gray Bat

Myotis grisescens



Habitat: We live in caves all year long. We usually live in one cave during the summer and a different cave during the winter.

Eats: beetles, flies, moths, mosquitoes

95% hibernate in the same eight caves!



Indiana Bat

Myotis sodalis



Habitat: We usually hibernate in groups of thousands from October to April. We can travel long distances to find the right cave.

Eats: moths, beetles, hard-bodied insects

First discovered in Indiana!



Tri-colored Bat

Perimyotis subflavus

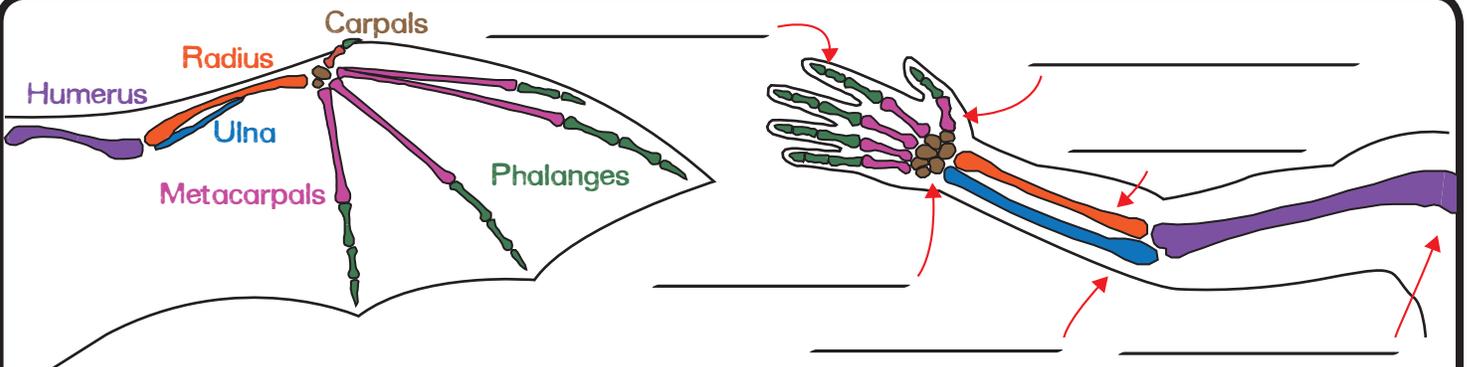
Habitat: We like to live on the edge of forests. We retreat to caves and mines during winter to avoid the cold.

Eats: gnats, beetles, moths, flies

Can each catch an insect every two seconds!



Bat Anatomy



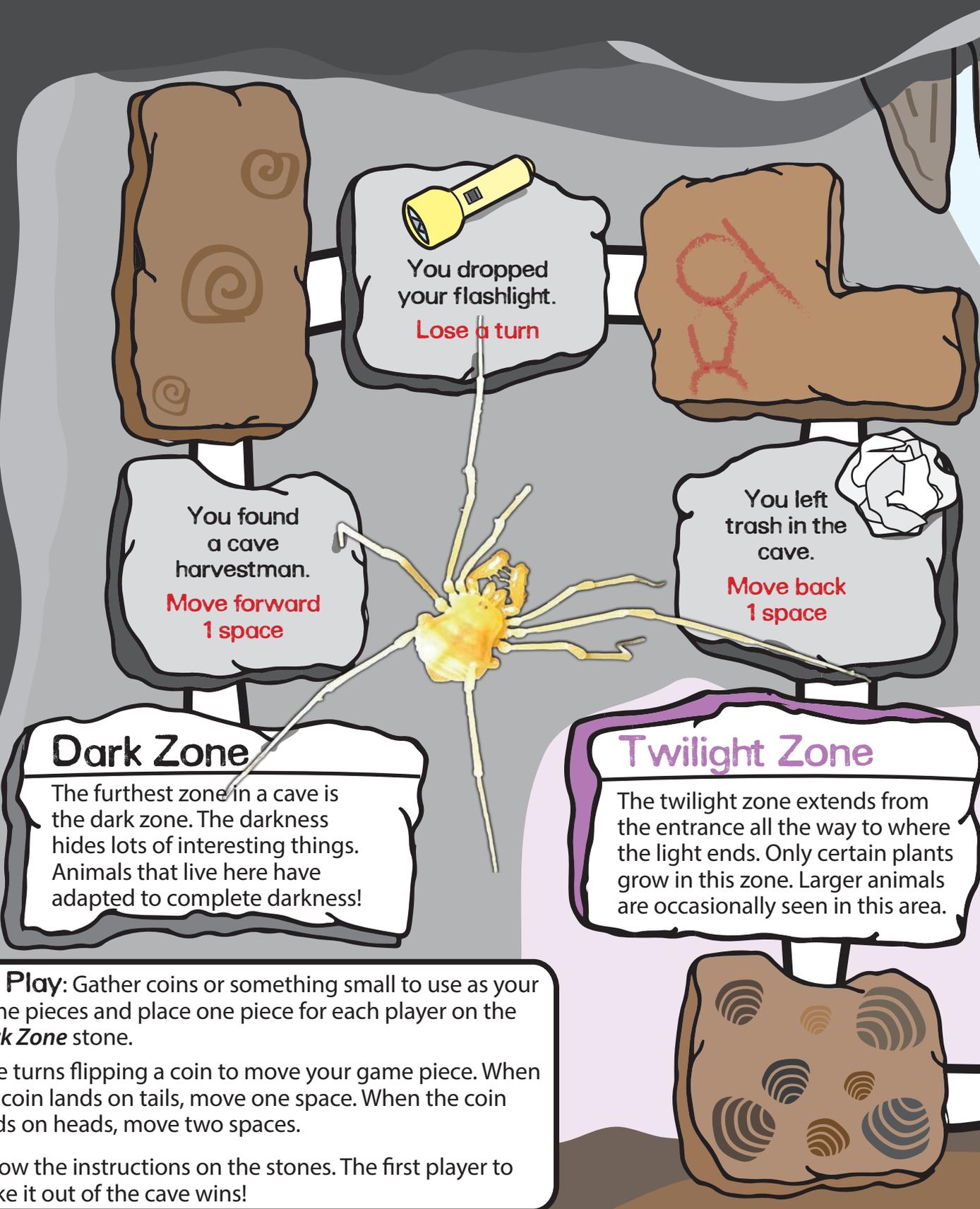
Bats are mammals, just like you! Look at the bones inside a bat wing and the bones inside a human arm. The bone structure is very similar. Can you find these similarities? **Fill in the blanks to name all of the bones.** *Hint: Use the colors as clues*

Zones of a Cave

The deeper you go into a cave, the less light there is. Caves are separated into three zones depending on how much light the zone receives. In this activity, start from the deepest part of the cave, the dark zone, and pass through the twilight and entrance zones to make it out of the cave.

Follow the stones and make it out of the cave!

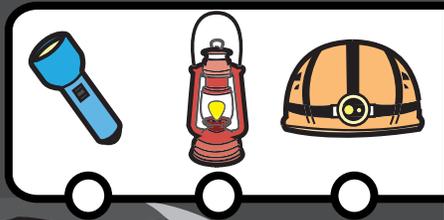
Start



To Play: Gather coins or something small to use as your game pieces and place one piece for each player on the **Dark Zone** stone.

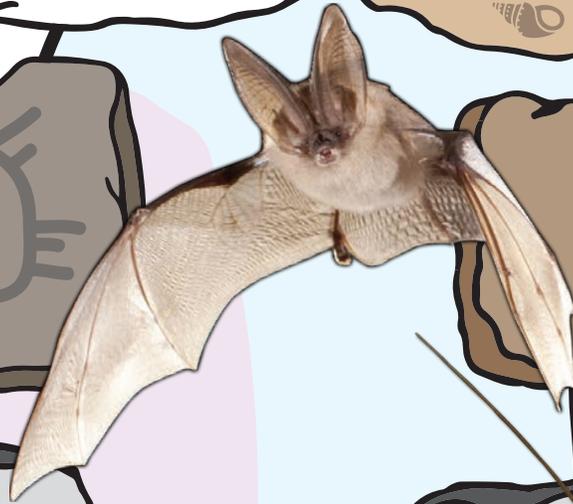
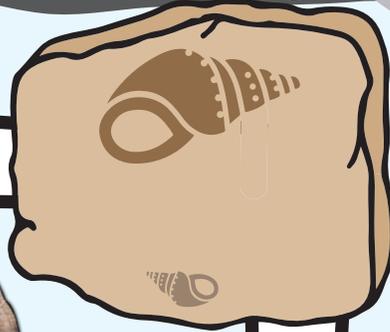
Take turns flipping a coin to move your game piece. When the coin lands on tails, move one space. When the coin lands on heads, move two spaces.

Follow the instructions on the stones. The first player to make it out of the cave wins!



Entrance Zone

The entrance zone is the brightest. This is where both plants and animals receive enough light to live.



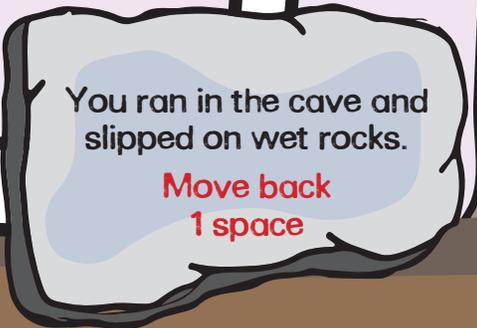
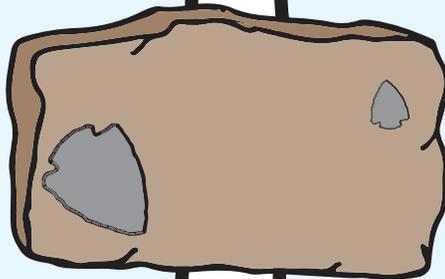
You reported seeing a bat with a white nose to a park ranger.

Move forward 3 spaces



You saw a cave cricket.

Move forward 1 space



You ran in the cave and slipped on wet rocks.

Move back 1 space



You took something out of the cave.

Move back 5 spaces

You made it out!

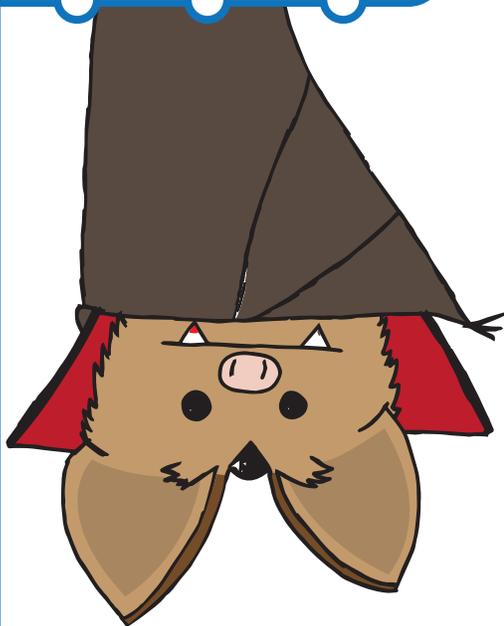
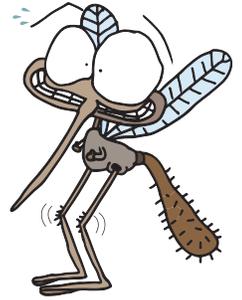
Dispelling Batty Myths



Bats are blind! Bats are vampires! There are many myths about bats and it is your job to debunk these myths. **Fill in a bat fact and complete the activity at the bottom of the page with friends and family.**

I Want to Suck Your *Blood*

Not all bats feast on blood. There are only three species of bats that lick the blood of their victim after making a small bite. Vampire bats do not live in the United States. Bats in the United States mainly eat insects. One bat can eat over 1,000 mosquito-sized insects in one hour!

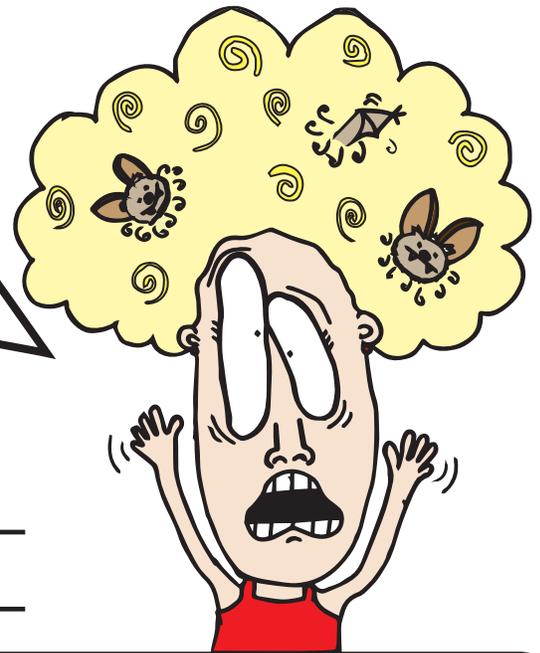


Blind as a Bat

Bats use sound waves that bounce off objects such as flying insects to "see", in a process called **echolocation**. They use echolocation to find food and navigate through the darkness. Some bats also use their eyes to hunt prey due to echolocation's short range.

Help! They're in My Hair!

Bats do not want to land in your hair! Bats are found in many places. They live in caves, trees, or in structures such as barns. Thousands of bats live under bridges across the United States. Even on a bad hair day, your head is not a place for a bat.



Bat Fact

Write down your favorite fact about bats.

Bat and Moth Activity

Group of 3 or more

Let's see what it is like to be a bat by using echolocation!

Objective: The "bats" try to tag all the "moths", while the moths try to avoid the bats! Once all the moths have been tagged, switch teams.

- Rules:**
- Set play area boundaries and split into two teams (bats and moths).
 - Blindfold the bats or have them close their eyes for the entire activity.
 - Whenever a bat says "bat", the moths must respond by saying "moth".



Finding Fossils in Caves



Paleontologists study the remains of ancient life. Caves are ideal places to preserve fossil remains for thousands or even millions of years. Fossil remains can range from tiny shells to skeletons of bears! There are two categories of cave fossils: fossils preserved in walls and bedrock, and fossils that accumulate in caves.

Fossils in the Walls

Most caves form in **carbonate rocks** such as limestone, dolomite, and marble. These are **sedimentary rocks** that may contain fossils. Fossils in cave walls are often marine invertebrates (ocean animals without a backbone) which help us learn about ancient environments.



Special Delivery: Fossils in Caves

There are different ways fossils end up in caves. These include fossils from animals that die in caves, animals that fall into caves, or the remains of animals brought in by predators.



Never disturb fossils you find while on a caving adventure.



Body Fossils or Trace Fossils

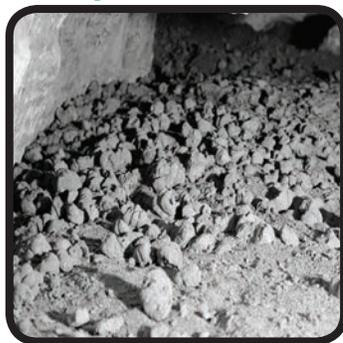
Body fossils are any type of body parts including shells, bones, teeth, and plants. Trace fossils include tracks, burrows, and coprolite's (fossilized poop).



Label each picture as a trace or body fossil



Skeleton



Sloth Dung

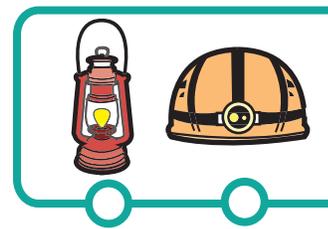


Vertebra



Tracks

Evidence of Ancient Animals



Speleo-Fact: In 1976, an illegal fire in Rammpart Cave (Grand Canyon NP) destroyed 70% of a prehistoric sloth dung deposit.



Packrat Middens

Packrats make nests and glue them together with their urine! Fossilized rodent urine is called **amberat**. Pack rats gather materials from all over which creates a lot of debris. The piles of debris are called **middens**. Scientists use ancient plant material from middens found inside caves to learn about past climates.

Save the California Condor

Could you imagine a bird with a 10 foot (3 meter) wingspan flying right above you? By 1987, the California condor, one of North America's largest birds, could no longer exist in the wild due to exposure to lead, habitat loss, poaching, and pesticides. After the successful actions taken by government agencies, American Indian tribes, zoos, and environmental groups, there are now more than 160 of these birds living in the wild. Condors lay their eggs in caves, rock crevasses, and large trees. 12,500-year old condor bones have been found in caves, proving they have been part of the ecosystem for a long time!



How does protecting caves also help save the California condor?

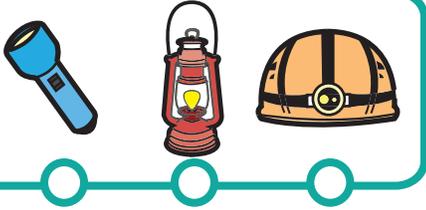
What information do caves provide about the California condor?

What are three factors that contributed to the decrease in the California condor population?

Why do you think it is important to try to save the California condor from going extinct?

Visit www.nps.gov/grca/naturescience/california-condors.htm to find out more about California condors.

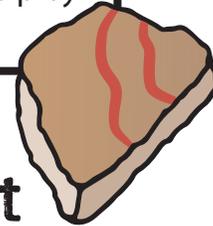
Travel Back in Time with Cave Archeology



Caves in the United States have provided shelter for humans for more than 10,000 years. **Artifacts** left in caves provide information about the daily lives of American Indians. These artifacts include items such as pottery, arrowheads, and baskets.

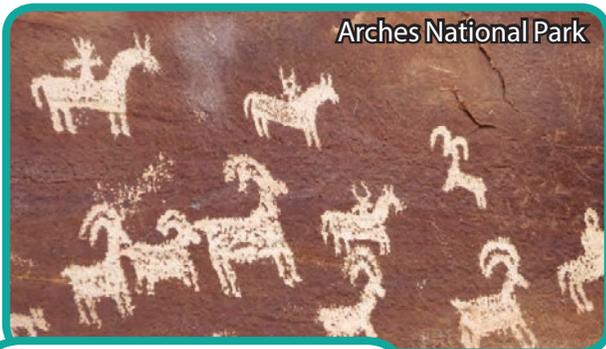
It is not "Finders-Keepers"

Pieces of broken pottery are called **sherds**. These artifacts are culturally significant and also provide archeologists with clues about the past. As a Junior Cave Scientist, it is your job to protect artifacts in caves. Help by reminding others not to pick up, touch, or take home any artifacts.



Pictures are Portals to the Past

Cave drawings provide a glimpse into the lives of people who lived long ago. **Pictographs** were made by painting on cave walls or rocks, while **petroglyphs** were created by carving, chipping, or cutting into the rock.



Arches National Park



Dinosaur National Monument

Label these two as either a pictograph or a petroglyph.



We never leave drawings or signatures in any cave. Instead, create your own cave art in this box.

Karst is All Around You



Speleo-Fact: The land surface of the United States is 20% karst.

Karst describes a landscape that forms when weak acids (**carbonic** and/or **sulfuric acid**) in groundwater dissolve bedrock. Karst can range in size from small caves to entire landscapes. In the map below, you can see that most states have some karst nearby.

Sinking Streams



Russell Cave National Monument

Sinking streams are streams that drain into the ground at **swallets** or **swallow holes**. Water that goes into sinking streams may eventually come out at a karst spring.

Karst Springs



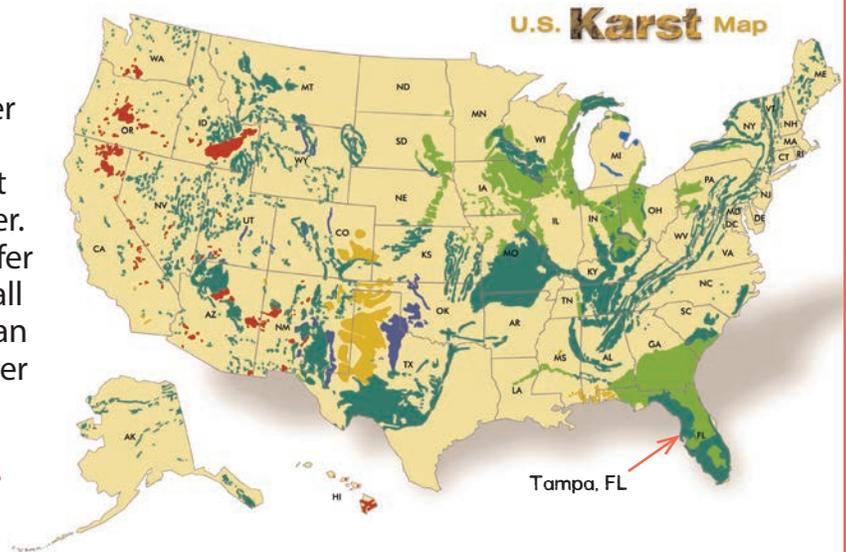
Ozark National Scenic Riverways

Water flowing through karst systems emerges from a cave or other openings as a **karst spring**.

Underground Water

In the United States, 40% of the groundwater that we drink comes from **karst aquifers**. A karst aquifer is a body of carbonate rock that can store and transfer large amounts of water. The Floridan Aquifer—the largest karst aquifer in the United States—extends from Florida all the way to South Carolina! It yields more than 250 million gallons (946 million liters) of water per day.

What rock type do you live on if your home is in Tampa, Florida?



Rock Type

Carbonate Rocks (limestone, dolomite, marble)	Exposed
	Buried under 10 to 200 ft. (3 to 60 m) of non-carbonates
Evaporite Rocks (gypsum, halite)	Exposed
	Buried under 10 to 20 ft. (3 to 60 m) of non-evaporites
Pseudokarst	Volcanic
	Unconsolidated material

Karst Topography Model

Build this 3-D model to see how water travels down a sinkhole and out of a karst spring.



Visit go.nps.gov/learnkarst for a printable model and instructions.

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Living with Karst

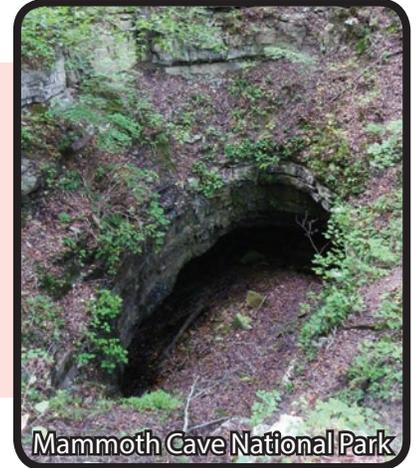


Karst systems are complex and always changing. We need to plan carefully when living in karst areas and be aware of potential problems. **Learn more about living with karst and answer the questions.**



Do Not Trash Sinkholes!

Sinkholes are holes in the ground formed when water has dissolved away the bedrock. Throwing trash or other contaminants into sinkholes threatens groundwater systems, the water you drink, and the surrounding environment.



Mammoth Cave National Park



National Corvette Museum

Putting the "Cars" in Karst

Many people live near or directly on karst where the collapse of cave passages and formation of sinkholes are normal processes. Building near, or on top of, karst can be dangerous. One of the best strategies for living with karst is to learn more about our surroundings and what is beneath our feet. In February 2014, a giant sinkhole formed beneath the National Corvette Museum in Kentucky swallowing several classic cars.

How many cars do you see? _____

What is the term for where a stream goes underground?

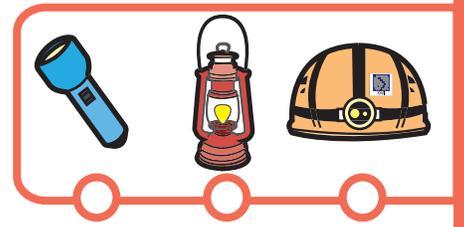
What acids are responsible for dissolving bedrock in karst systems?

What are three factors that can contribute to groundwater pollution?

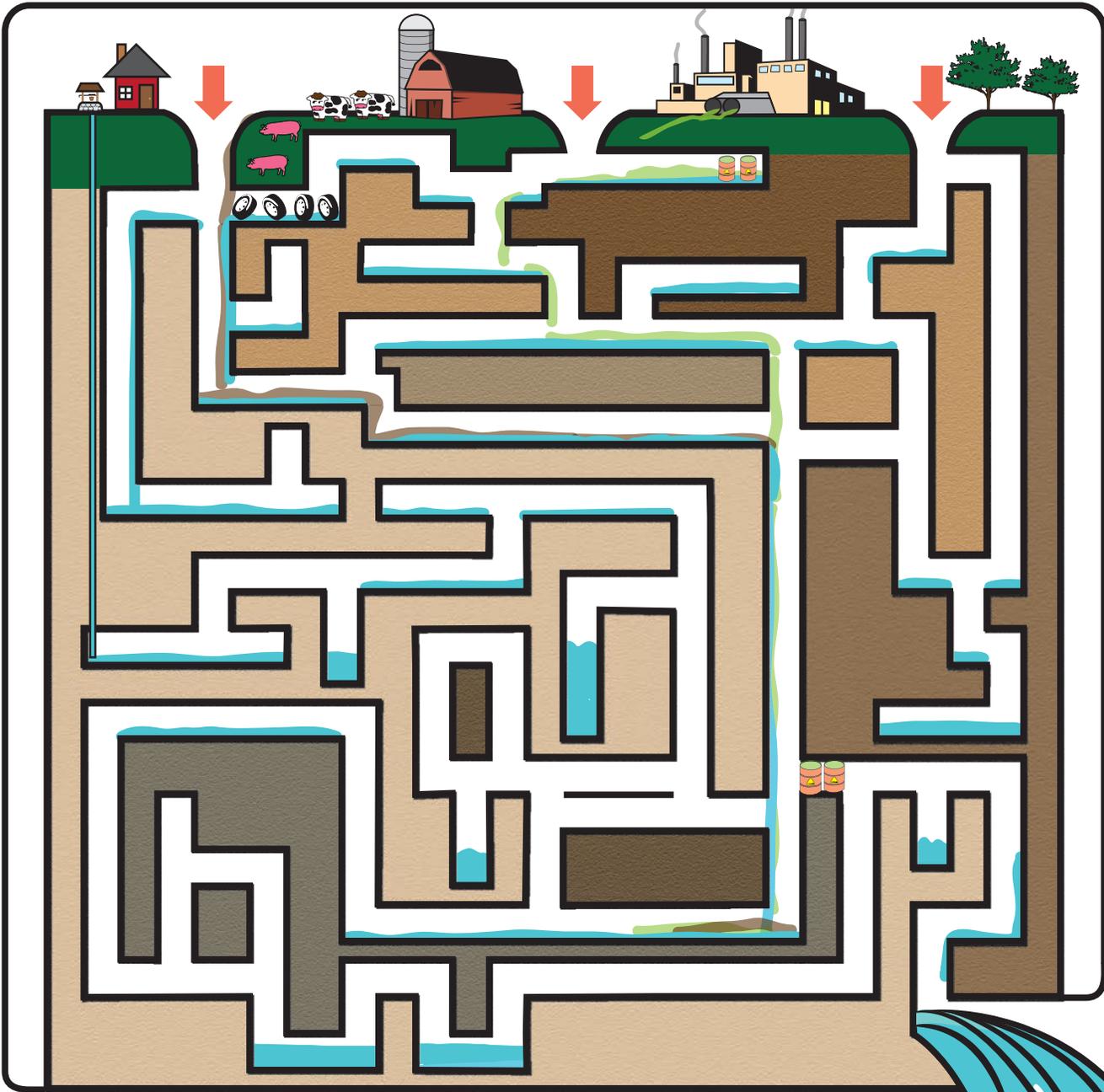
What do you think is the coolest fact about karst?

Look at pages 19–21 to help answer these questions.

Find a Solution to the Pollution



Karst systems can be damaged by things that happen at the surface. **Pollution** by trash, sewage runoff, industrial chemicals, pesticides, herbicides, and fertilizers can harm karst environments. Some of the water we drink travels through karst. It is your job to minimize pollution. **Solve the maze. Enter through any of the three sinkholes and avoid as much pollution as possible.**



How do actions at the surface affect what happens below the surface?

How can you help keep groundwater clean?



Caves Need Care



Caves and karst landforms are fragile resources and can be harmed or damaged by humans. It is your job as a Junior Cave Scientist to **conserve** these resources and enjoy caves for the adventures they have to offer. Caves take hundreds of thousands of years to form. We must ensure they are still here for future generations.

Write a poem about caves. Start each line with the letters in the word "cave".

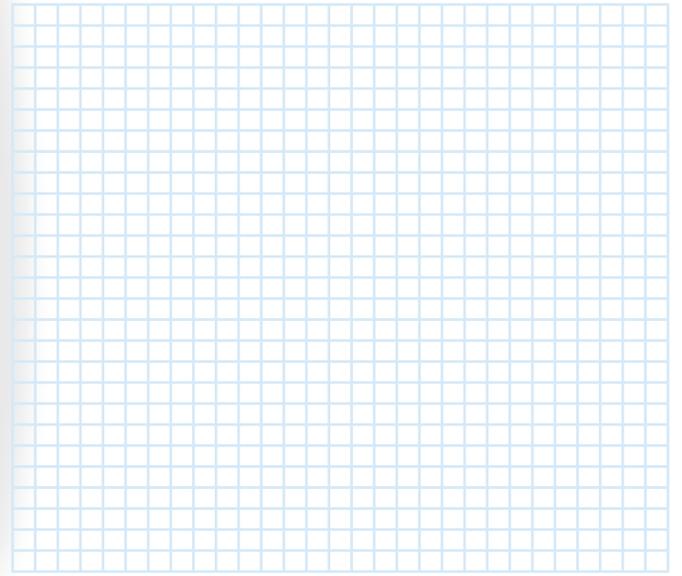
C

A

V

E

Draw your favorite thing about caves or other karst landforms.

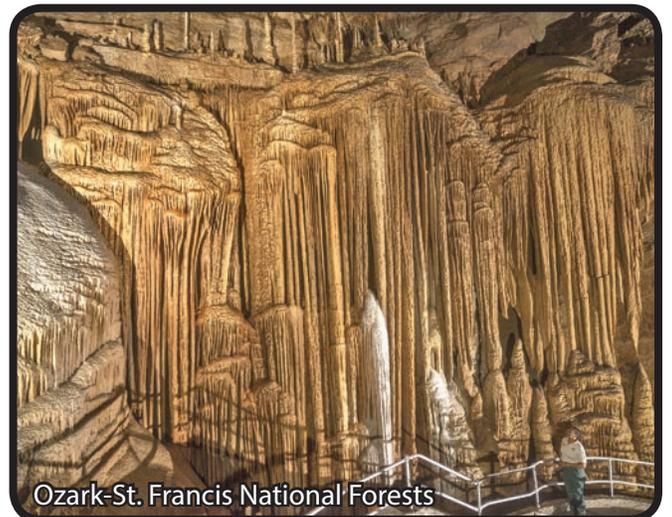


Mammoth Cave National Park

Historic Graffiti

Many caves in the National Park System have old signatures from early visitors. These historic signatures hold cultural significance but are very destructive to the cave. Visitors are no longer allowed to write their names in caves. This helps **preserve** the cave's natural beauty for everyone to enjoy.

Why will you try your best to preserve caves and karst landforms for future generations?



Ozark-St. Francis National Forests

Junior Cave Scientist Pledge

As a Junior Cave Scientist, I promise to:

EXPLORE

magnificent and beautiful caves;

LEARN

about caves and karst systems and the work that speleologists do; and

PROTECT

our public lands and the things that make caves and karst areas special.

I promise to enjoy our public lands and share what I learn
with my friends and family.



Sign or print your name



Junior Cave Scientist Certificate of Achievement



has successfully completed the requirements to be
an official Junior Cave Scientist

Educator/Ranger Signature

Date





Project

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Illustrations

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Additional Support

Yusuf Abubakar, Melissa Baier, Paula Bauer, Charles Bitting, John Burghardt, Erin Cahill, Tim Connors, Pam Cox, Maggi Daly, Jamie Dawson, Katie Frassinelli, Mike Gallant, Lisa Held, Jacquelynn Hilton, Dianne Joop, Jason Kenworthy, Ronal Kerbo, Kids of GRD, Cami McKinney, Lila Mohesky-Roybal, Bill O'Donnell, Colleen O'Connor Olson, Rebecca Port, Ellen Rohn, Vincent Santucci, Barbara Tallman, Karla Tanner, Jenn Tarlton, Nick Wightman, Carol Zokaites



Bats in Crisis

White-nose syndrome (WNS) has killed more than **6.7 million** bats in the United States and Canada. WNS can spread from bat-to-bat, or soil-to-bat. It may also be spread by humans carrying spores of the fungus *Pseudogymnoascus destructans*, or "PD", on their clothing or equipment.

Your Help is Needed!

- Stay out of caves and mines where bats are hibernating.
- Honor cave closures. Check with your state and federal agencies for the status of caves and caving in your area.
- Report bats showing signs of WNS, and bats that are dead, dying, or appear diseased, to your state wildlife agency.
- Help spread the word about WNS and the value of our bats.

For more information on bats and WNS, visit:

go.nps.gov/wns • www.whitenosesyndrome.org • www.batcon.org