

# Exploring Caves Teaching Guide



Exploring Caves is an interdisciplinary set of materials on caves for grades K–3, covering geology, cartography, and hydrology. This packet contains a poster, an instructional book, and a list of multimedia resources on caves. The instructional book contains a read-aloud story, lessons, and student activity hand-out sheets.

## About This Instructional Unit

At first, teachers may find the study of caves to be somewhat intimidating. Caves entail at least five scientific disciplines: earth science, hydrology, mapping, biology, and anthropology. Each of these disciplines involves a unique content area as well as the development of particular intellectual skills. This unit aims at helping teachers to sort and organize the most important ideas in this rich scientific area. Detailed lesson plans serve as ways to pass these ideas on to very young students.

The unit capitalizes on the fact that caves are associated with many centuries of dramatic lore and adventure. The unit links cave adventure with scientific truth, and such important issues as safety and the environment. Hopefully, this combination of elements will provide students with an unforgettable learning experience — and teachers with a little well-earned enjoyment.

The cave-related material in the unit juxtaposes sets of ideas designed to stimulate thinking and new ways of looking at the world. Some of these combinations include:

- geology and water action
- light/darkness and biology
- light/darkness and anthropology
- environment and safety
- environment and legend.

Where these ideas intersect, students will develop interesting concepts, assisted by the materials provided here. For example, cave animals living out their lives in total darkness is a curious concept that one of the lessons helps to explain. Lessons sometimes focus on a seemingly bizarre or curious situation as a way of drawing attention to a scientific concept.

The lessons in this curriculum offer an interdisciplinary mix of skills development. Teachers are encouraged to use a variety of skill-development activities. The unit is designed to maximize the greatest diversity of student learning styles. Skill activities include:

- scientific observation
- research
- reading, vocabulary, and writing
- inference and deduction.

## Organization of the Unit

The core of this curriculum unit is an original five-chapter, read-aloud story that describes the adventure of two children who get lost in a cave and are led to safety by a talking bat. This fictional story is designed to introduce students to a wealth of information about caves. Each chapter has a coloring handout illustrating the action in the chapter, and a set of lesson plans designed to reinforce or expand upon the scientific and environmental elements in the chapter.

The poster provides an accurate and detailed illustration of a limestone cave and its animal inhabitants. At the top of the back of the poster, the pictures and text describe key events in the story. These illustrations are included in the packet as coloring handouts. The poster also serves as a teaching tool: other types of caves are depicted, and environmental and safety issues are addressed.

Each chapter is accompanied by the following types of materials:

- Follow-up activities
  - coloring handout
  - discussion questions
  - vocabulary
  - writing exercise
- Lesson plans
  - demonstrations
  - research/observation
  - reading

### **Suggestions for Using the Unit**

Each lesson has four information tags: difficulty level, science topic, discipline, and special skill. The lessons are designed so that you can do some or all, depending on available time or interest in a topic. Some are more suitable for older students and some for younger students. Most activities can be easily adapted to meet the needs of your age group.

The read-aloud story and follow-up activities make this unit useful for kindergarten and first grade teachers, despite the somewhat technical content. Teachers of very young students can use the story elements alone and add some of the art and music activities.

The images on the poster are sufficiently dramatic and varied to appeal to all age groups.

Using the information tags for the lessons, teachers can also organize the unit topically, focusing, for example, on science topic (geology), discipline (reading), or special skill (computer).

### **Information for Teachers**

The List of Multimedia Resources includes books, articles, World Wide Web sites, and organizations. Please refer to the resource list some weeks before you teach the unit. These resources contain background information you may find helpful when teaching the unit.

Additionally, you may wish to order brochures or supplementary teaching materials from “show caves,” or contact cave organizations (both are listed in the resource list). You would be wise to allow four to six weeks for delivery of such materials.

## Chapter 1: Lost in the Cave

The rain pelted down so hard they could hardly see. The two children ran through the heavy rain. They held their arms over their heads, but it was no use. “I’m soaked!” Jenny yelled to Carlos, “My clothes are all wet!”

“Me too!” Carlos yelled back. “We’ve got to get out of this rain and away from the lightning!” He clapped his hat on his head. The two friends ran on down the muddy path.

Frantically, they searched for somewhere to take shelter. All they could see was rainwater pouring down a grassy hill.

Carlos and Jenny were at science camp. They had taken a walk to the camp headquarters, just half a mile away. Now, coming back, the short walk seemed like a 10-mile trip. They could hardly see the path before them.

Deep thunder rolled overhead. “Look, Carlos!” shouted Jenny. She pointed to a shadow under a huge, flat rock sticking out of the hill. She ran over to the rock. Under it was a space not big enough to stand in. Jenny kneeled down and crawled in. Carlos followed her.

Sitting under the rock, they caught their breath and rested. Their tiny shelter kept the rain off, but it was uncomfortable and small. Carlos turned his head and noticed a large hole behind them leading into the hill. “I bet it’s nice and dry in there,” he said. He crawled into the hole. Jenny shook her wet hair and crawled after him.

The dark shelter felt pleasantly dry and warm. “This is neat!” Carlos said.

“Carlos!” Jenny cried. “Did you hear that *echo*?” They both listened.

... *that echo* ... *echooo* ... The sound bounced back and forth around them.

“Let’s check it out,” Carlos said. “This might be a CAVE! It’s getting bigger, I think.”

... *biggerithink* ...

The children laughed to hear the echo again, and then to hear their laughing echo. They crawled farther into the cave and soon they could stand up. They walked along a stone wall. Slowly, the light got dimmer and dimmer.

Carlos and Jenny turned around a rocky corner. Suddenly, they were in total darkness. They reached out to touch the wall. Instead, they touched empty space. They turned around and touched another wall. Was it the same wall? They couldn’t tell. What was going on? Suddenly they couldn’t find their way back.

Where was the cave entrance? They backed up, looking for something familiar. But everything was black.

“Oops!” Jenny bumped into Carlos, who fell down hard on the cave floor.

“Sorry, Carlos!” Jenny could hear Carlos brushing off his pants as he got up. “Here’s my hand,” she offered.

Carlos groped in the dark until their fingers touched. “I’m scared Jenny. I think we’re lost.”

They stood still, listening. They could no longer hear the sound of the storm. How had they come so far inside the cave so quickly? Which way should they go to get out?

Out of the silence they heard the trickling sound of water. It sounded like a small stream, along with dripping sounds. Was it raining that hard outside?

*Flap! Flap! Flap!*

“What was that?” cried Carlos.

“Something flew over my head” Jenny screamed. “Something’s flying around in here.” She waved her arms over her head.

*Squeak! Squeak! Squeak!* The two children looked up toward the sound. They couldn’t see anything, but a tiny voice squeaked at them.

*Calm down! I’m just over your head. Be careful!*

“Huh?” Carlos reached up. His fingers briefly touched a small, warm animal, with short, silky fur.

*Don’t touch me!* said the squeaky voice.

“I don’t want to touch you!” Carlos said. “What are you?”

*I’m a bat, of course. Who else would be flying around in a cave? Batman?*

Carlos and Jenny both laughed. They explained to the bat that they were lost and had to get back to science camp. Could the bat help?

There was a long silence. The two friends realized that this bat could be their only hope of getting out of the cave. Would he help them?

Finally, the squeaky voice replied, *I guess I'll help you. I like talking to people. I can take you to another cave entrance that will be a shortcut to your camp. That way you can stay out of the rain. I can show you the rest of the cave, too.*

Carlos wanted to go right back to camp, but he loved adventures. Besides, it was probably still pouring rain out there. "Gee, Bat, that would be great. I'd love to see the cave, too."

"But Bat," protested Jenny, "how can we see the cave? We can't see anything in the dark. And aren't you blind as a bat? How can you see anything either?"

*Good point, said Bat. But . . . my eyes are quite good actually, when there's some light. In the dark, I use another way of seeing . . . my bat sonar helps me find my way around. Maybe I can teach you to see in the dark without your eyes.*

"You gotta be kidding," said Jenny.

*No, said Bat, Just follow me!*

The children heard Bat's wings flapping off into the darkness.

"Bat! Stop!" Jenny cried out. "We can't see you! How can we follow?"

*Flap, flap, flap.*

Bat flew back. *I'm sorry, he squeaked. I forgot. Can you two hold hands and follow my directions?*

Carlos was shy about holding hands, but he grabbed Jenny's belt and waited. Bat told them to walk 10 steps forward.

*Hurry up, the bat squeaked.*

**BANG!**

"Ow!" First it was Jenny, then Carlos. "I bumped my head on the cave ceiling! Bat, your directions are lousy."

*Oh, I'm sorry again, the bat squeaked. I forgot how big you are. I just flew into this tunnel here. I forgot that you have to bend over to get in. Oh, I am so sorry.*

Jenny rubbed her sore head and remembered hearing the bat flapping above their heads. Everything about bats and people seemed different. "It's OK, Bat," Jenny said. "Just try to remember that we can't see and we're much bigger than you."

*OK, kids. Up ahead, you're going to have to kneel down and crawl. It's a long tunnel and it's muddy because of the rain.*

The children crawled through the blackness. Jenny complained about getting mud on her clean jeans. Carlos didn't like the moldy smell. They both hated the cold, slimy mud on their hands.

*Stop!* squeaked their tiny commander. *Jenny, look for a nice surprise on the floor, just in front of you.*

Jenny stretched out her hand.

"A flashlight!" she yelled happily. "Oh thank you, Bat! Oh I hope it works!" She wiped the mud off the flashlight with her T-shirt.

*Flap, flap, flap. Time to rest.* They heard Bat's voice from above them somewhere.

*Some cave explorers were here a few weeks ago, drawing a map of the cave. They dropped the flashlight.*

"Turn on the light, Jenny!" cried Carlos. "Turn it on! Let's see the cave!"

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Earth science Geology Biology
<i>Disciplines</i>	Science Reading/writing

## **LESSON 1.1** Reading Follow-up Activity

### Activity Summary

Students will discuss preliminary concepts of the unit, including cave safety. A coloring handout illustrates a cave entrance.

### Educational Goals

Students will be able to:

- State the first safety rules of cave exploration.
- Discuss what they think a cave is.
- Explain why it is so easy to get lost in caves.
- Explain that cave entrances may be small and inconspicuous, even if the cave is very large.

### Materials Provided

- Handout 1: Reading Follow-up Coloring Page

### Materials Required

- Crayons

### Procedure

1. Distribute Handout 1: Reading Follow-up Coloring Page.
2. While students are coloring, talk about Discussion Questions.
3. Incorporate New Words into writing and vocabulary lessons.
4. Assign writing topics to advanced students.

### Discussion Questions

1. The first rule of caves is “Never go into a cave without a guide.” Why is this rule important?
2. The second rule of caves is “Never explore a cave without learning cave safety rules and methods.” Why is this important?
3. What is a cave?  
*(Brainstorm ideas in preparation for Lesson 1.2.)*
4. Have you ever been in a cave? Would you like to visit a cave? Would you be scared?
5. Some places have lots of caves. Other places have none, or few caves. Do we live in an area with caves? Do you know why? *(Depends on the rock formations in your area. See Lesson 1.3.)*
6. Why would it be hard to find your way in a cave? *(If you don’t have a map of the cave, you could get lost in its complicated structure, even if you had a flashlight. Darkness makes it even harder.)*
7. How big are cave entrances? *(Some caves have tiny entrances, others have large entrances. Cave entrances may be hidden by large stones, tree trunks, plants.)* Show where the cave entrance is on your picture.
8. Have you ever seen a bat? What time of day was it? *(Bats fly at night and rest during the day. Even in cities they can be seen overhead. The best time to look for them is at dusk, just after sunset.)*

9. In real life, do bats talk? (*No, but they do make squeaky noises.*) Why do you think that writers make animals talk? (*It makes it easier for writers to tell the story.*)

**New Words:**

*All grades* . . . . . bat, cave, echo, entrance, tunnel

*Kindergarten* . . . . black, feel, floor, hat, hill, lost,  
top, wet

*Grade 1* . . . . . breath, camp, crawl, dark, feet,  
drip, over, night, rain, stream

*Grade 2* . . . . . bump, darkness, fur, fly, lightning,  
field, squeak, storm,

*Grade 3* . . . . . adventure, entrance, silence,  
thunder, dimmer, blind

**Writing Assignment**

Write one paragraph (three to five sentences) on one of the following topics:

- Name three reasons why you think caves are exciting places.
- List three reasons you would visit a cave.



<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Earth science Geology Mineralogy Biology
<i>Disciplines</i>	Science Reading

## LESSON 1.2 What Is a Cave?

### Activity Summary

In this activity, students will explore their existing concepts of caves and match them with a working definition to use during the unit.

### Educational Goals

Students will be able to:

- Define the word “cave.”
- Name the two types of rock formations in which most American caves occur.
- Define “show cave” and “wild cave.”

### Materials Required

- Samples of lava, limestone rock, and marble, if possible. Lava and limestone gravel can be obtained at hardware stores or lumber yards.
- Large newsprint pad

### Procedure

1. Write “What is a cave?” on the blackboard.
2. Ask students to brainstorm words they associate with caves. Use the following questions to stimulate some of the information:
  - Where do we find caves?
  - Are special kinds of rocks found in caves?
  - Do certain kinds of animals live in caves?
  - Do people use caves for some activities?
  - What makes caves?
  - Name some famous caves you have visited.

3. Refer to the poster (side 1) as children discuss what they already know about caves.
4. From the discussion, write a definition of caves that the class agrees upon. (Explain to younger children what a “definition” is.)

5. The class definition should include the following points:

A cave is:

- A hole, tunnel, or series of branching openings. These are often called caverns or rooms.
- Underground or underwater, mostly in darkness.
- Usually formed in rocks called limestone, marble, or lava.
- Usually created by water dissolving limestone (over periods of thousands of years). Rivers and streams sometimes go underground as part of their course. Then, they are called “sinking streams.”
- Often the site of unusual rocks (stalagmites, stalactites, flowstone) formed by water dripping onto or flowing through a cave.
- Often home to people and animals, including some animals that can live without light (bats, crickets, blind fish).
- Often very large. (One cavern in Carlsbad Cavern, New Mexico, is longer than 14 football fields. A series of caverns in Flint Mammoth Cave, Flint, Kentucky, is roughly 190 miles long. The deepest cave in the world, Reseau Jean Bernard, in France, is 5,035 feet deep — nearly a mile underground.)

- A place sometimes open to the public, on government-administered land or in commercial areas for pay. Such public caves are called “show caves.” Some caves are on private or other land where the general public cannot go. These are called “wild caves.”

6. Write the class definition on newsprint. Post on the wall for the duration of the unit.

<i>Grade Levels</i>	2, 3
<i>Science Topic</i>	Geology General
<i>Discipline</i>	Science Reading/literature

## **LESSON 1.3** Cave Stories — Tales of Adventure

### **Activity Summary**

One reason children are so fascinated with caves is that nearly every culture has stories and legends, modern and ancient, about caves and cave creatures. The purpose of this activity is to sharpen student appetites for scientific learning by hearing cave stories.

### **Educational Goals**

Students will be able to:

- List three things about caves that interest them.
- List reasons why writers choose caves as settings for stories.

### **Background**

Caves and cave animals figure in numerous popular stories. Why? There are many reasons. Caves have often served as secret hiding places for people, treasures, or other secrets. As recently as the Civil War, cave minerals were used secretly to make ammunition in caves. Caves are inherently dangerous. Their darkness guarantees both danger and mystery.

Caves also offer extraordinary beauty, as any geologist or caver will testify. The bizarre shapes and colors fascinate people of all ages.

Then, of course, there are bats, providing a rich lore of legend in nearly every culture. Oddly enough, in our culture, the legends have built up around vampire bats. Vampire bats are found only in the American tropics and are a tiny fraction of all bat species. In China, on the other hand, graphic symbols of bats represent good luck rather than evil.

To prepare for this activity, please consult the List of Multimedia Resources. See what you can find in your school and local library.

In many children's stories, caves bring together all the elements of good stories:

- interesting characters
- mystery, hidden things
- unusual and bizarre animals
- history and legend
- bizarre shapes, colors, smells
- danger.

### **Materials Required**

- Stories, books, videos, comics, and other materials on caves and cave animals and people.
- One piece of notepaper, envelope, and first class postage stamp per student.

### **Procedure**

1. Consult resource list to collect cave-related materials.
2. Ask class to name stories that relate to caves.
3. Invite students to read stories or watch videos during the unit.
4. Contact the National Caves Association (See List of Multimedia Resources) for places to obtain free information. Ask students to write letters to request brochures or pamphlets on "show caves." (Send multiple letters to the same cave in one package to speed up handling).
5. Discuss questions below.

## Discussion Questions

1. Suggest some reasons why caves show up in so many stories. (This asks students to combine two factors — the cave environment and elements of good fiction).
2. Why do caves make good places for fantasy and adventure stories? (Teacher may wish to read from *Tom Sawyer*, *Ali Baba and the Forty Thieves*, or other works.)
3. Are the caves shown in popular cave stories very real? What gets left out? (Popular cave stories tend to leave out the unpleasant detail, the danger, the mud, etc. Bat stories emphasize false or unpleasant details, leaving out the important role U.S. bats play in insect control. Movies, by necessity, make caves appear to have more light than they really do. Students will learn more of these realities as the unit progresses.)
4. Many bats are in stories too. What makes them exciting characters for stories? (Their unusual bird/mammal appearance, their night habits, their specialized sonar sensory perception, vampire bats and legends, etc.)

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geography Mapping
<i>Disciplines</i>	Geography

## **LESSON 1.4** Find a Cave

### Activity Summary

This activity shows the “big picture” of caves in the United States and provides a geography lesson. Students will see that limestone caves are not isolated oddities of nature but part of larger natural systems. They will find out how close or far away they live from a major cave and perhaps consider visiting a cave some day.

### Educational Goals

- Students will be able to locate their own communities and the nearest caves on a map of the United States.
- Intermediate and advanced students will be able to calculate the distance to their nearest cave, using a rough scale.

### Teacher Background

Your class may live near rock formations rich with caves. Or, you may have no nearby caves. Caves are concentrated in areas of the United States rich with limestone formations. These areas are located in parts of the Northeast, Midwest, and Western regions of the country.

### Materials Provided

- Handout 2: U.S. Map With Cave Locations

### Materials Required

- Wall map of the United States
- Ruler

### Procedure

1. Post U.S. map on the wall.
2. Distribute Handout 2: U.S. Map With Cave Locations. Explain that the dots represent major caves in general, not just the “show caves” that people can visit. Some “show caves” are in parks; others are commercial. You must pay to get into most “show caves.” Caves that are on private land, undiscovered, not visited, or closed to the public are called “wild caves.”
3. Point out or ask a student to indicate the location of the class’ community (city, region, or State, depending upon student’s background) on the large wall map. Ask students to mark the same location on their desk maps with a small “x.” Circle the nearest cave or caves.

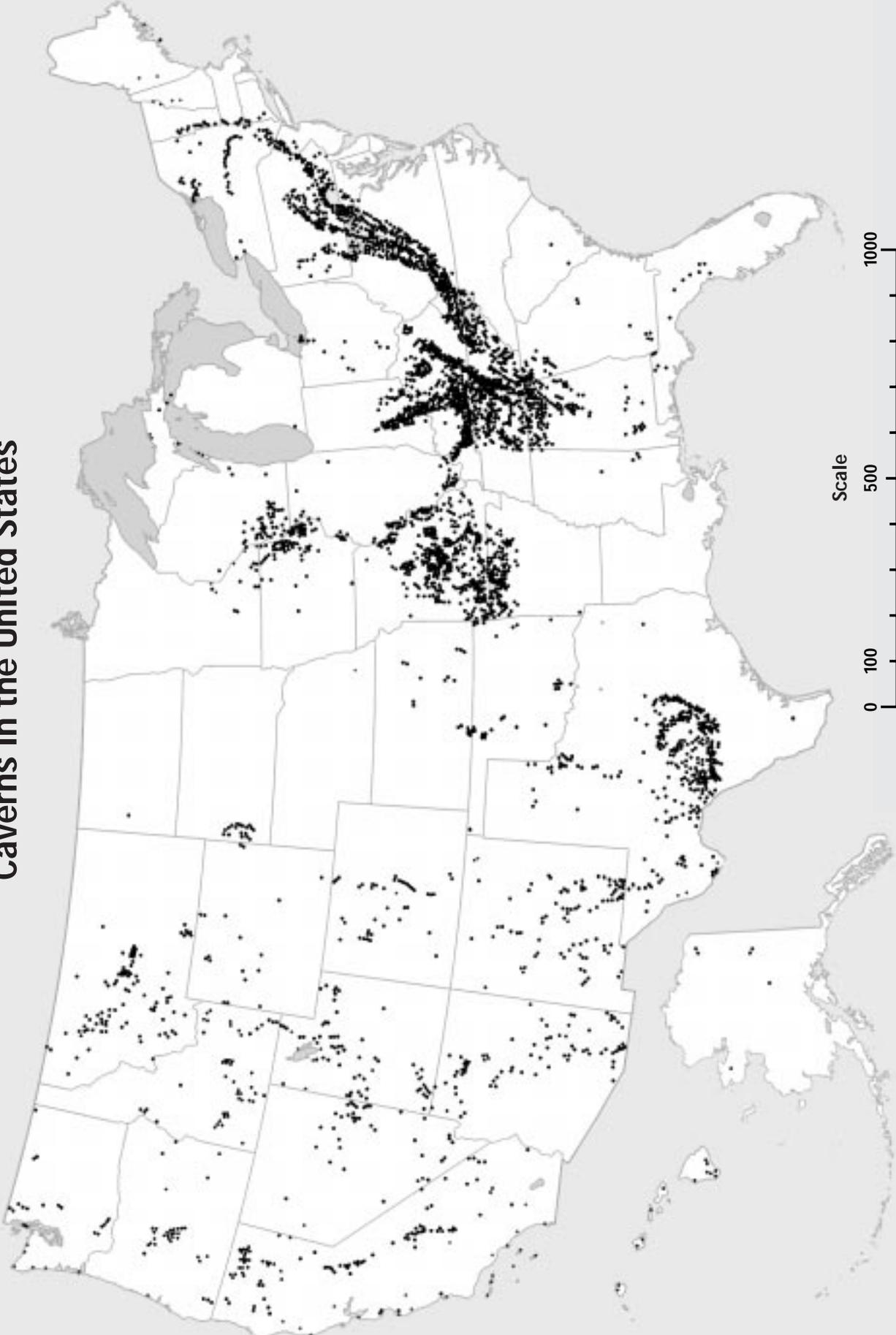
The following activities are for more advanced students.

4. Tell students to draw lines around two big areas of the United States where there are many caves. Tell them that they have probably just mapped two “limestone areas.” Most U.S. caves are found in limestone rock areas. A few are also found in volcanic lava areas.
5. Ask students to use their rulers to measure the distances between their hometown and various caves, as the crow flies. With younger students, explain that the ruler distances help to figure out real distances. Short distances on the ruler are short *actual* distances on the land. Which cave is the nearest? What cave is farthest away?

Find the name and location of the nearest cave. Have students write for more information about that cave and others that interest them. You may be able to pull up information on the cave on a Web page also.

6. Have older students multiply the ruler distance times the scale factor to find out the distance in miles. Can they also figure out how many miles across the whole United States?

# Caverns in the United States



Adapted from the *National Atlas*, U.S. Geological Survey, 1970.

## Chapter 2: Bat Shows Off the Cave

Jenny switched on the flashlight the bat had discovered. Now they could see in the dark. She and Carlos stared at the underground world in amazement. Strange rocks decorated the cave. Some hung from the ceiling, like icicles. Others, like pointy tree stumps, grew from the floor. Flowery crystals grew from the wall where Carlos stood. Jenny stared at curtains of pinkish stone draped down the walls across from where she stood. Both children were struck speechless in this dark and lovely place.

For the first time, they could see their cave guide. The bat hung upside down by the little claws of his hind feet. He dangled from a ledge on the cave wall. They could see his brown snout and big ears. Dark, glittering eyes stared out from a black mask. A coat of chestnut brown fur made him look warm and cozy in the dark cave. Strangest of all were his paper-thin black-brown wings — folded up close to his body like brown paper napkins.

The children had never imagined anything like this cave. As their eyes got used to the faint light of the flashlight, more and more curious structures appeared. They didn't know where to begin looking.

*The cavers I met made maps of the cave. Too bad you two don't have a map,* teased Bat.

The children did not think it was a funny joke. But they wondered.

“What's a caver?” they asked.

*Oh, they are people who like to explore caves,* Bat explained. *They wear special clothes and boots. On their heads, they wear helmets with lights. They also carry flashlights. They climb up and down the cave walls with ropes. They act pretty goofy sometimes and laugh a lot. They draw little maps in notebooks.*

“I wish we had some caver equipment like that,” Carlos said. Many questions were going through the children's minds.

How did this cave get here?

Why didn't anybody at science camp know about this cave?

Was it safe to be here? Would rocks fall on their heads?

Where were the water sounds coming from?

How would they get out of here?

Bat's squeaky voice broke into their thoughts. *You see why I wanted to find you the flashlight,* he commented. *Let me show you around now.*

Bat spread his little brown wings. He launched himself from the cave wall and flapped around in circles over the children's heads.

“Hey Bat,” Carlos asked, “how do you see in the dark with this sonar you told us about?”

*Well, remember the echoes you heard? It's kind of like that. The squeaks you hear — I use those for talking to other bats mostly. I can tell how close something is by making a signal that you humans can't hear — only I can hear it. The signal goes out and hits things — like the wall. Then, an echo bounces back and hits my big ears. If it comes back fast, I know I'm going to hit the wall or something pretty soon — like you and Jenny did back there. So I make a turn. If the echo takes a longer time to come back, I can keep going for a while without hitting something.*

“Do you always use sonar?” Jenny asked.

*No. I use my eyes when we fly out of the cave in the evening, before it gets really dark. And in the cave, sometimes I forget to use my sonar and I bump into things just like a human. It's embarrassing.*

Jenny giggled. “It's like you have two pairs of eyes,” she said. Carlos took the flashlight and looked around at the strange rock shapes. He asked Bat how they got there.

Bat flew to a nearby rock hanging from the ceiling. He hung from the ceiling and started to answer. *Well . . .*

“And why is everything wet?” Carlos interrupted, “I've heard water dripping from somewhere ever since we got in the cave. And somewhere I can hear a stream too.”

*. . . it took water and stone to make this cave. See the rock all around us? It's called limestone. The cave used to be solid rock. It used to have cracks in it, but the cracks got wider and wider until they turned into caves and tunnels.*

“How do the cracks get so big?” asked Jenny.

*Water trickles down through the earth above us. Especially when it rains like today. And it rushes through the limestone in underground streams.*

*When the water goes through cracks in the limestone, the limestone dissolves away slowly, because the water has a little bit of acid in it. It's a little sour.*

*As the limestone cracks get wider, more and more water can flow through the cracks. After a while, the water can become an underground stream.*

"You mean water can make rock go away? Like water makes soap go away in the bathtub?" Carlos asked.

*Well, I don't know what soap is.*

Bat thought for a minute.

*I've watched the cave explorers make tea. Sometimes they put sugar in the tea and the sugar goes away. It dissolves. The rocks are like the sugar.*

*Even hard rocks like limestone dissolve. But in a cave it happens slowly. Over a long time — oh, like twenty-five thousand years — the cracks get bigger and bigger. Some of the cracks turn into tunnels, like the one you just crawled through. After awhile the tunnels get bigger and bigger. Some of them join with other tunnels and we get big cave rooms.*

"Did the tunnels dissolve into big rooms like this?" Jenny asked. "Is the rock in this cave still dissolving?"

*Oh yes. The rock in this cave is dissolving all over the place. Listen to all that water dripping! The tunnels grow into big rooms. Cave explorers call big cave rooms 'caverns.' Later on, I'll show you a place where the whole ceiling is dissolving away. Eventually, it could become so thin it will collapse. Then it's called a sink hole.*

The sound of drips went on. The children couldn't tell which drips were drops or which were the echoes of drops. They wondered how many drops could carve out such a big thing as a cave. Carlos thought it would be even slower than the growth of tree rings they had seen at science camp.

"What about these weird shapes?" Jenny asked. "How do they get here? We don't see these above ground."

The Bat went on. *No, you don't, Jenny. It's water again. When water drips through the limestone, it picks up tiny bits of limestone. You know, dissolved in the water, just like sugar in tea. So you can't see it. When a drop hits the ground, the water dries up. The limestone in the water gets left behind — or deposited. A coating of tiny crystals slowly builds up.*

Bat looked at the icicle shapes hanging from the cave ceiling. *Or down, he added. That's how these strange stones take shape. And it's slow again. It takes thousands of years to make some of these rock shapes.*

*It's funny, laughed the bat. In one part of the cave, water deposits the crystals. In another place, water dissolves crystals away.*

"I don't believe this. Water can't do all this," said Jenny doubtfully. She stepped back to look at the rocks hanging from the ceiling.

"Watch out Jenny!" Carlos shouted.

Just in time, Jenny glanced behind her. A small stream was flowing through the cave behind her. It was a fast-running stream, but she had not heard it. Her foot dipped into the stream. Splash!

Jenny yanked her dripping foot out of the water as if she had stepped into a hot campfire.

"Oh no! My foot's all wet," she complained. Carlos shone the flashlight on her as she shook off the wet foot. The worried Bat flapped around in circles.

Suddenly Jenny put her foot down. She stared into the stream.

"Carlos!" she whispered. "Look there! Shine the light in the water. Something's over there. Look! There's . . . oh, I don't believe it!"

Carlos and Bat moved closer to see what she was talking about.

A silvery white creature glided through the water. Then it darted off like a flash of light, a watery ghost. It disappeared behind a rock.

*Oh, hi fish. Bat squeaked. This is Jenny. Sorry she fell in your stream. She won't hurt you.*

Bubbles streamed up from the fish, still hiding behind a piece of limestone. "He nudged my foot," Jenny said. "I think he was trying to say hello." The children listened as the bat squeaked excitedly.

*I'm glad the fish is back, said Bat. Last year, limestone caved in under a garbage dump on the surface. It caused a sink hole. The garbage and pollution in the sink hole fell into this underground stream. Most of the cave fish got very sick from the poisons in the garbage. This fish was OK because she was laying eggs in a place that didn't get the poison. You can see why troglobites don't like people very much.*

"Trogl-what's?" Jenny and Carlos asked at once.

*Troglobites, cave dwellers, the bat explained patiently. Don't you humans know anything? The cavers knew the word. They say that troglobites are animals that can't ever leave the cave or live anywhere else. Here we have white troglobite daddy longlegs and salamanders and centipedes. They look different from their surface cousins, but they are close relatives.*

*Now, many have no eyes, and are pale or white, like Ms. Fish. In the stream we also have some pale white shrimpy creatures and crayfish.*

“So why are troglobite fishes white?” asked Carlos.

*Carlos, laughed the bat, turn off your flashlight. Can you see any colors?*

The cave went dark. “No, of course not,” Carlos responded.

*Right. Troglobites don't need colors in a cave. So their bodies don't waste energy making colorful skin or scales. Just like they don't need eyes either.*

“I liked Ms. Fish,” thought Jenny out loud. “All silvery in the stream. She looked like a ghost. I can't remember seeing her eyes.”

“Are you a troglobite, Bat?” she asked.

*No, I'm a troglonexene — a cave visitor. I spend a lot of my time in the cave — I like it here. But I leave the cave when I want to, especially at night. Troglobites have to stay here. They've changed so much that they can't live up there anymore.*

*Used to be there were really big troglonexenes, like cave bears. Cave earthworms are cave visitors too. If they wanted to, they could live in your lawn.*

“Bat, we must be cave visitors, just like you,” Jenny said.

Carlos laughed. “Yeah. We're troglonexenes, right?”

*Now you two are getting silly, the bat said. But you're right, I think.*

“Do troglobites find their way around with sonar like you?” Carlos asked.

*Oh no. Ms. Fish can't see but she can feel things really well with her skin and smell things in the water. In*

*fact, I bet she can feel the water shake when you talk. And crickets have really, really long feelers, he said. They can feel and smell you coming long before you can spot them.*

Are there any other kinds of animals in the cave? asked Carlos.

*Why yes — the troglophiles, the cave lovers. These animals, like some kinds of cave spiders, could live above, but they spend their whole lives in a cave instead. They like cave life.*

By this time they were walking through the tunnel. Carlos was thinking about cave animals, not paying much attention. He certainly wasn't paying attention to everything being so slippery — the moldy rocks on the cavern floor, the slimy cave walls, and oozing mud in the tunnel.

Carlos suddenly slipped and fell back. The flashlight banged on the wall and clattered down on the rocks below. Light flickered for only a moment on the cave wall.

“Oh no!” cried Carlos, feeling around in the dark. The light died. The cave was lost again in thick darkness. Even the bat flapped in surprise.

For a moment, Jenny imagined that she had become a troglobite. Had she turned white? Were long feelers growing out of her head? Just to make sure that she was still a normal human, she reached up to her face. Yes, she still had eyes, but they were eyes that could not see. She had no feelers to guide her through the tunnel.

*My ears! Jenny thought. Without my ears and my hearing, I could be lost forever in this cave!*

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geology Mineralogy Hydrology Biology Anthropology
<i>Disciplines</i>	Science Reading

## LESSON 2.1 Reading Follow-up Activity

### Educational Goals

Students will be able to:

- Explain how water and limestone interact to form caves.
- Define “troglomite,” “troglone,” and “troglophile.”
- Describe some of the dangers of cave exploration.
- Explain how water makes cave rock formations.

The lesson can be used to prepare students for a cave field trip, or as follow-up after a trip.

### Materials Provided

- Handout 3: Reading Follow-up Coloring Page

### Procedure

1. Distribute Handout 3: Reading Follow-up Coloring Page.
2. While students are coloring, talk about Discussion Questions, below. Ask them to point out the following items on their coloring page: cave fish, limestone, troglones, troglomites, troglomiles, crystal formations, and underground stream.
3. Incorporate New Words into writing and vocabulary lessons.
4. Assign writing topics to advanced students.

### Discussion Questions

1. There are two kinds of caves: “show caves” and “wild caves.” “Show caves” have guides, paths, and lights to show the rock formations. “Wild caves” have none of these, and can be quite dangerous. Which kind of cave is this story about? Have you ever been in a “show cave” or a “wild cave?” Show the class cave brochures from commercial and park caves.

2. How does water help make caves?
3. What is the main kind of rock in American caves? (*Limestone and related rock such as marble*)
4. Limestone was made from the skeletons of coral and seashells millions of years ago in the bottom of the ocean. What could you find in limestone? (*Fossils of ocean animals such as coral and clams*)
5. Other caves are made in lava rocks. Where does lava come from? (*Volcanoes*) What parts of the United States have lava? (*Western United States, including Hawaii and Alaska*)
6. Discuss examples of “troglomite,” “troglone,” and “troglophile.” What are the differences?

### New Words:

*All grades* . . . . . cave, fish, dissolve, limestone, sonar, troglomite, troglone, troglophile, caver

*Kindergarten* . . . . . claw, ears, safe, worm, black, brown

*Grade 1* . . . . . lovely, joke, pair, shone, snout, stone, strange, stump, wings

*Grade 2* . . . . . amazement, brown, tunnel, soap

*Grade 3* . . . . . comment, mistake, napkin, flap, cavern

### Writing Assignment (Grades 2–3)

Think about what you have learned so far. Write three questions that you would like to ask a talking cave bat.



<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Biology Geology
<i>Disciplines</i>	Music

## LESSON 2.2 **Rock Music**

### Activity Summary

In this activity, students use limestone and other rocks to create percussion instruments. Students use the instruments to perform a song.

### Teacher Background

This activity offers a lighthearted musical celebration of rocks and the cave story. If you are musical, teach the activity as a song. If you're tone deaf, try an old-fashioned choral reading. Either way, the activity gives new meaning to the familiar phrase "rock music."

The key to this activity is the musical instruments — rocks. Students and teachers will create percussion instruments from local rocks. After the "instruments" have been made, the class will learn the *Rock Music* song. Neither students nor teachers will forget the look, feel, and sound of limestone or lava after this activity.

Students will bang their stones together after the last two words of the chorus line —  
*You make ROCK MUSIC!*

### Educational Goals

Students will be able to:

- pronounce some multisyllabic cave vocabulary words fluently.
- demonstrate and explain the role of percussion instruments in musical performances.

### Materials Provided

Handout 4: *Rock Music* Lyrics

### Materials Required

1. "Rocks" and "Rattles" — percussion "stones" for each student. For Rocks, the student should have a pair of fist-sized stones, preferably limestone. For Rattles, students should have various sizes of gravel — limestone, if possible. (Ask them to look for white, grainy rocks or rock materials.)
2. Containers for instruments (oatmeal boxes with lids, plastic jars with lids, etc.) Do not use glass containers.
3. Piano, guitar, or other accompanying instrument, if possible.

### Procedure

1. If you cannot sing well or read music, invite a musically inclined teacher or parent to help with this activity.
2. Ask students to choose a musical instrument: either a Rock or a Rattle instrument. If the teacher does not supply the rocks, the students should be asked to bring in appropriate materials for rocks and containers.

For rocks: collect two child-fist-sized rocks (2–3-inch) per student. You may take one of two approaches to obtaining the instruments. Ideally, ask each student to bring two fist-sized rocks to class. In some neighborhoods, you might bring in a bucket of rocks yourself.

For rattles: for each student, collect a cup of gravel — different sizes of gravel (pea gravel, aquarium

gravel, limestone gravel, lava). Students should seal the gravel inside a container.

Encourage students to decorate their instruments with paint, ribbons, sparkles, or natural objects. Encourage cave motifs.

3. Encourage students to compare the sounds made by their instruments. A word of warning — banging fist-sized rocks of nearly any variety sounds the same and is hard on the ears. It's best done outdoors, or in a large room or an auditorium.

Some rock instrument sounds will be higher in pitch, some lower. It may be difficult to distinguish the difference. Encourage concentration on the sounds. A music teacher could make this a good exercise on pitch.

Ask students to name “real” percussion instruments.

4. Distribute Handout 4: *Rock Music* Lyrics to students. Ask them to read alone, then ask them to read the words together to get the pronunciations and the beat. With prereaders, teach words by rote.
5. Demonstrate when to clap the rocks together (just after the words “Rock Music”). Have class memorize the rhythm.
6. Give sheet music to accompanist. (The sheet music is printed on the back of the original of Handout 4.) Introduce melody by singing or playing guitar accompaniment (only two chords are required).
7. If possible, have the students perform the piece (either as a song or as a choral reading) for an audience (including other students) or at a community concert.

# ROCK MUSIC

Inside a dark cave underground  
with echoes sounding all around  
you are lost, without a clue.

Whatever should you do?

**You make ROCK MUSIC!**

Heed the bat who says, “Oh please  
crawl upon your hands and knees.

My sonar ears will guide us through —

And cheer up, you know what to do!”

**You make ROCK MUSIC!**

Light in a cave shows pretty sights  
with stalagmites and stalactites.

If you’re lucky there’s a chance

you’ll even see the troglobites dance

**to the ROCK MUSIC!**

# ROCK MUSIC

Lyrics Leslie Dawson

Music Tim Dawson

Piano

1 Boys Girls (through cupped hands) Boys Girls

*pp* In - side a dark cave un - der - ground, with ech - oes sound - ing all a - round, You are lost, with - out a clue. What

7 All Rocks Boys

ev - er should you do? You make Rock Mu - sic. Heed the bat who

Shakers

13 Girls Boys Girls

says "Oh please, crawl u - pon your hands and knees. My son - ar ears will guide us through and cheer up, you know

19 All Rocks Boys

what to do." You make Rock Mu - sic. Light in a cave shows a

Shakers

24 Girls Boys Girls

pret - ty sight with stal - ag - mites and stal - ac - tites. If you're luc - ky there's a chance you'll e - ven see the

30 All Rocks

trog - lo - bites dance to the Rock Mu - sic.

Shakers

34

*p* *cresc.*

<i>Grade Levels</i>	2, 3
<i>Science Topics</i>	Geology Mineralogy Hydrology Biology Anthropology
<i>Disciplines</i>	Science Geography

## LESSON 2.3 Cave Diagram

### Activity Summary

This activity takes a closer look at limestone cave geology and hydrology, using a cutaway drawing of a cave system. Students will learn additional cave vocabulary, and consider the implications of underground structures on planning human communities.

### Educational Goals

- Students will be able to:
  - Define dry cave, wet cave, underwater cave, sink hole, shaft, and water table.
  - Describe at least two ways that pollution can enter cave systems.
  - Explain why it is important for communities in limestone areas to map their cave formations.
- Students will be able to explain that bats are not blind, and how they use sonar to navigate in the dark.

### Materials Provided

- Handout 5: Cave Diagram

### Procedure

- Ask the question: Why is cave mapping important? Discuss answers. (*Maps prevent cavers from getting lost. They also keep road and building constructors from building on sink hole areas, and maps help prevent pollution of underground water.*)
- Distribute copies of Handout 5: Cave Diagram.

Locate and discuss new features that have not been discussed before:

*Dry cave:* a cave with no standing water or streams.

*Tunnel:* a long, narrow, horizontal passage.

*Shaft:* a long, narrow, vertical passage, going up and down or sloped, which may require special climbing equipment. Vertical shafts are often located at the bottom of sink holes.

*Sink holes:* places where a cave used to be near the surface. When the limestone roof of the cave collapses, a sink hole is created. On the surface, a sink hole might just look like a steep hole. (Note: one sink hole is labeled. Ask students to locate the others.)

*Sinking stream:* a stream suddenly disappears underground into a cave system.

*Water table:* the level below which all openings in rock are filled with water.

*Wet cave:* a cave with underground standing water, seepage, streams, or ponds.

*Underwater cave:* a cave that develops below water level. Cave divers explore these caves.

- Ask students to use a blue crayon to trace all the ways that water can get into the caves. Remind them that water will seep through soil. Ask them to color all bodies of water above and below ground. Use a red crayon to show how pollution could move from the factory, through cave passages, to the ocean.

4. Ask students to identify underground features that could be dangerous to people.

*Sink holes:* If people do not have good cave maps, they won't know where sink holes are developing. Because of this, many houses, roads, animals, and farmlands have fallen into sink holes.

*Shafts:* Good cave maps will show where shafts are. Cavers can use climbing equipment to get in or out of shafts. Maps will also keep people from falling into shafts in caves.

5. Ask students to identify dangers to caves.

*Sinking streams:* If streams are polluted, they can carry pollution to cave fish and other animals. Pollution can come from houses, from factories, and from roads.

*Sink holes:* Many people use sink holes for dumping garbage. Pollution from garbage can harm cave animals.

6. Ask the students what they would change about the drawing if they were in charge of where to build factories, houses, and roads. Discuss.

## Discussion Questions

1. If bats are not blind, how do they find their way in the dark?
2. Why are no two caves the same shape?

## New Words:

*All grades* . . . . . diagram, dry cave, wet cave, underwater cave, shaft, sink hole, sinking stream, pollution, water table

*Kindergarten* . . . . . wet, hole

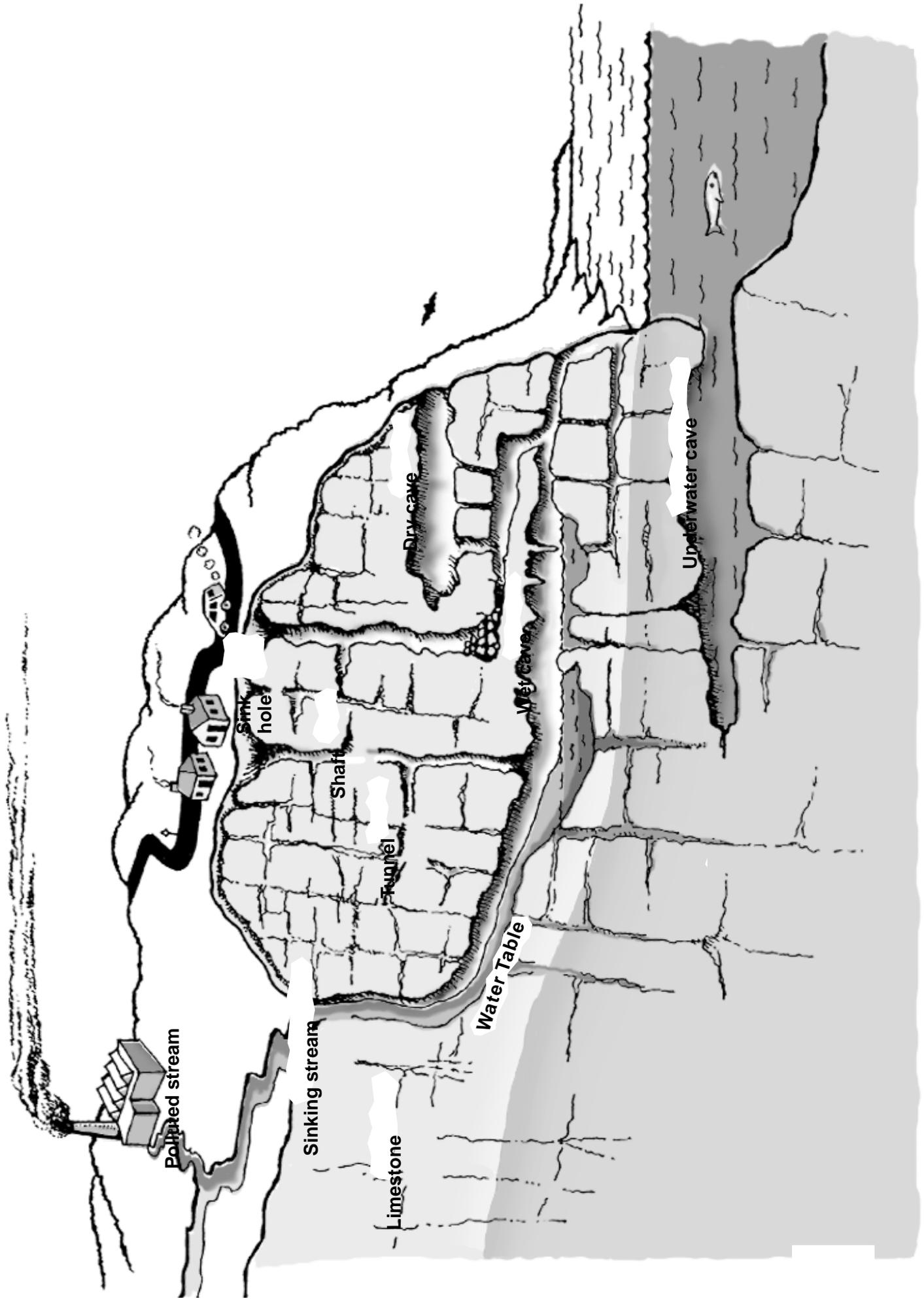
*Grade 1* . . . . . dry, stream

*Grade 2* . . . . . danger, tunnel, diver

*Grade 3* . . . . . sink, pollute

## Writing Assignment

1. Think about the different openings where water goes underground. What happens next? Write a paragraph describing how rainwater gets into a wet cave.
2. Think about how bats "see" in the dark. Explain how bat sonar works.



## Chapter 3: A Strange Lunch in the Cave

The flashlight had gone out, and the children were lost again in the pitch black of the cave. Somebody sniffled in the dark.

“Carlos, caves are dangerous, I think,” whispered Jenny, rubbing her nose on her sleeve. “We could be lost in here and nobody would ever know where to look for us. Thank heavens we brought our lunch.”

Carlos agreed. He thought about the dark and the moldy tunnel they had crawled through. He remembered slipping on damp loose rocks, and the stream. He thought of the slippery mud all over his boots.

*Calm down kids, squeaked Bat. You just have to follow instructions. I'll get you out.*

“Yes, but you are used to the dark. We're scared and both of us are cold and wet.” Jenny sniffed again, and rubbed her nose on her sleeve. She shivered.

Then a new thought hit her. “Carlos! We've got sweaters in our backpacks. Oh, I'm going to put mine on right now.”

The two friends took off their packs and pulled out their warm, wooly sweaters. They put the sweaters on under their jackets. They felt better right away.

The Bat squeaked, *Let's go. I want to get out in time for supper, too.*

Bat swooped down from a rock overhead. *Kneel down*, he squeaked. He warned that they were about to crawl through another tunnel, and this tunnel followed the same stream where Jenny had scared the fish. Bat told Carlos to switch off the flashlight and carry it in his backpack, even though it didn't work anymore.

*Don't leave it lying around. Battery chemicals can get in the water and hurt the fish.*

“Oh — that's pollution,” Carlos said. “We learned about that in science camp.” As he placed the flashlight in his pack, his fingers touched the peanut butter sandwich he had brought along for lunch. His stomach growled hungrily.

“I sure hope we can get out of this tunnel and stop for lunch pretty soon,” he told Bat.

Bat tried to encourage them. *Try to stay on the side of the tunnel so you don't get wet. I'm sorry it's hard, but this is really the shortest way out, kids.*

Splash! Splash! The children got wet anyway. They stumbled through the stream tunnel. Now and then they stopped to rest. They grabbed each others' hands for a few minutes. Carlos was surprised to find out that he really did feel scared. He tried to think about hot chocolate instead. Even thinking about it made him feel better.

*Hey, let's keep moving. This is hard on me, too. Normally I sleep all day. With all this extra flying, I'm getting tired. I'll have to catch a million extra bugs when I go out to feed tonight.*

“You wouldn't leave us here and go out to catch bugs, would you, Bat?” Jenny worried.

*Don't worry, I'll get you out of here in good time for us to have supper. But I'm hungry like you. I'm running low on energy, too. I have to make it to the cave entrance soon.*

*We can all rest soon though. I was thinking you could eat your lunch at the Bateteria room. You could meet my family, and just about all the cave animals eat there. How 'bout it?*

Jenny groaned. “What's that? A bat lunch room? Oh, I'd rather die.”

“Shush, Jenny. Be polite,” said Carlos. Carlos asked the bat, “Will we get there soon? If it's just a few minutes, we could wait.”

*It's just around the corner, said Bat. In fact we're out of the tunnel now. I'm going to hang myself up on the ceiling and rest for a bit.*

Bat told Carlos to get his lunch and the flashlight out of his backpack.

*Let's try something. Shake the flashlight, said Bat.*

Carlos did. To his great surprise, the light flickered and came back on.

The Bat explained. *I saw that happen with the cave explorers once. Now walk quietly and whisper.*

*Look up now, with the flashlight. See all the bats?*

When the children looked up, they were amazed to see hundreds and hundreds and hundreds of bats. Instead of flying around, they were hanging upside down from the ceiling, holding on by their tiny feet.

*We're under the bat colony. This is where the mom bats and the bat pups live. See the pups, hanging onto*

*the moms? I grew up there. Don't shine the light directly on the ceiling. Everybody's still sleeping until sunset.*

Carlos and Jenny peered at the mass of bats above them. It was hard to figure out just which bats looked like their Bat and his little sister. Hundreds of mother bats and bat pups hung from the stone ceiling. Most were asleep. Or maybe it was thousands, Carlos thought. It certainly sounded like millions of squeaks and chirps overhead as bats stirred in their sleep and made little murmuring noises. When Carlos looked closely he could see the babies nestled against their mothers' breasts.

*Look down now, said the bat. You can see a million troglobites eating here.*

A foul smell filled the room.

"Bat, what's that awful smell?" asked Carlos.

Bat ignored the question. He was used to the smell. *Put your hats back on*, he warned. They pulled their hats, still wet from the rain, out of their jacket pockets.

They soon understood why Bat had warned about hats. Carlos heard the steady *Ping! Ping!* of something falling on their hats.

Carlos shone the light on Jenny's hat.

"Jenny, uh . . . There's bug and bat droppings falling on your hat. And mine too! It's lice and mites and things. Don't take your hat off, for heaven's sakes!"

"Bat droppings? Ugh, how awful!"

Bat was insulted. *Oh no. We're very proud of our guano pile. He pointed to a huge mound of grey bat droppings under the bat colony. Valuable stuff. Sometimes part of the guano dissolves and forms rocks. And we feed the troglobites with it. Without bat guano, there would be no food to eat in here. All the crickets and salamanders and such would starve.*

The children were not impressed. "The odor. It smells moldy and awful," Carlos said.

*Well, lean over and see how many animals are eating the guano. They're not so fussy*, Bat replied. *A whole bunch of them — especially the little white springtails that hop all over the ground — eat the guano. And then there are the ones that eat the springtails — like the crickets and the beetles. Up top, there are the spiders that eat all the other guys. It's quite a system.*

The children obeyed — careful to keep their hats on their heads. They leaned over and looked at the guano. The flashlight showed hundreds — perhaps millions — of bugs crawling about. Pale white millipedes zipped across the pile. Pale wispy crickets with long, graceful feelers jumped about, along with long-legged daddy longlegs. Tiny springtails hid in the cracks.

*Some of the bugs eat the guano, and other bugs eat those bugs. Without us bats making guano, they'd all starve to death. We eat bugs out there, and turn it into food for the troglobites in here.*

"Why can't they eat plants?" Carlos asked.

*Do you see any plants here?* asked Bat. *And what do plants need?*

Then Carlos remembered. Plants need *light* to grow, of course! How silly to forget a thing like that.

Jenny and Carlos found a flat rock outside the bat guano area. They sat down to eat their sandwiches. They were used to the guano smell now, and they tried to ignore all the bugs around them. Inside their packs were peanut butter and jelly sandwiches, celery sticks, an apple, and a container of juice. In spite of the smell of the guano, they were very hungry and gobbled up their simple lunches.

"Look, Carlos. Look, Bat," Jenny said quietly. "The troglobites are coming here for lunch." She pointed the flashlight. On a spot near their rock, bread crumbs and celery leaves had fallen on the ground. Crickets and other bugs were busy carrying the crumbs away.

*You guys are kind of like bats*, noted Bat. *You're bringing food for cave critters. Just be sure you don't leave garbage behind.*

The children put their paper bags and containers back into their backpacks. They took a last look at the bats hanging from the ceiling, and followed the bat out of the Bateteria into a dark, damp passage.

*I wish your noses were as good as troglobite noses*, squeaked Bat. *You could find your way out of the cave. Lots of these animals smell their own trails to find their way around in the dark.*

Carlos imagined crawling around, smelling his own muddy footsteps. No thank you. He decided he'd rather put up with bossy Bat.

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geology Biology
<i>Disciplines</i>	Science Reading

## **LESSON 3.1** Reading Follow-up Activity

### **Educational Goals**

Students will be able to:

- Describe the living arrangements of a bat colony.
- Define the word “guano.”

### **Materials Provided**

- Handout 6: Reading Follow-up Coloring Page

### **Procedure**

1. Distribute Handout 6: Reading Follow-up Coloring Page.
2. While students are coloring, talk about Discussion Questions, below.
3. Incorporate New Words into writing and vocabulary lessons.
4. Assign writing topics to advanced students.

### **Discussion Questions**

1. What are the three groups of cave animals? (*Troglobites, troglonexes, and troglophiles.*) Encourage the class to pronounce the words out loud as a group. Although the words are long, they have a musical, amusing sound. Revisit the *Rock Music* song to help.
2. In which categories are the following animals: bat, pale cave fish, earthworm?

3. What would happen to cave animals if a bat colony were scared away?

Imagine a cave with no bat colony. What would happen if a bat colony moved in?

4. Where on your picture are crickets, the bat colony, and guano? Why are the bats upside down?

### **New Words:**

*All grades* . . . . . colony, droppings, energy, guano, millipede

*Kindergarten* . . . . . hard, ice, loose, rocks, sleep

*Grade 1* . . . . . butter, chatter, children, finger, joke, knee, scared, splash

*Grade 2* . . . . . sandwich, secret, stomach, supper, flashlight

*Grade 3* . . . . . stiff, critter, cricket, celery, odor, peanut

### **Writing Assignment**

Write a poem about cave animals that live in the dark. How can they find things in the dark? What do they eat? Do they have strange names?



<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geology Biology
<i>Disciplines</i>	Science Reading

## LESSON 3.2 Adapting to the Dark — Bats and People

### Activity Summary

Both animals and humans adapt to where they live in many ways. Both behavior and bodies are adapted to climate, food availability, and special features of the habitat. In the cave environment, bats have adapted superbly to a unique habitat. The students will consider how cavers also make adaptations to the cave. Finally, students will meet a real-life blind person, Joni, who makes adaptations to life in the dark.

### Educational Goals

Students will be able to define the word “adaptation.”

Students will be able to name:

- Three kinds of strategies for adapting: body changes, behavior changes (changing the way we act), and technology (special tools).
- Four aspects of the cave environment that require special adaptations.
- Five ways in which a bat’s anatomy or behavior has adapted to the cave environment.
- Three ways in which cavers adapt to the cave.
- Three ways in which blind people adapt to the dark.

### Materials Provided

- Handout 7: *Joni Adapts to the Dark*

### Teacher Background

Adaptation can be a useful concept for understanding both nature and ourselves. The cave environment requires adaptations of many kinds. This activity compares adaptations on an evolutionary scale — in the bat — and adaptations that can be made with behavior

changes and technology. It takes the student from adaptations of cave inhabitants to adaptations people make in their lives.

Included in this lesson is a true account of one person’s personal adaptation to the world of darkness, based on an original interview. Both blind people and many cave animals rely on memory, organization, and learning routine routes around their homes. Bats are so reliant on these routes that they sometimes fly without “turning on” their sonar. An unexpected change in the cave can cause a mid-flight crash. Other cave animals — insects, snails, and rats — leave scented trails wherever they go. They follow the scent to get back to their nests. The person in our interview gets her homing signal from the garbage dumpster in her parking lot.

See the List of Multimedia Resources for additional materials concerning the blind.

### Procedure

1. Write the word “adapt” in the middle of the blackboard. Discuss the definition: *Making changes that help an animal or a person get along better, or fit better in her or his environment.*

What kind of changes can animals and people make? Write down students’ ideas on the blackboard and draw out examples. Then ask them to generalize. Lead them toward three ways of adapting: body changes (evolution), changes in the way one acts or behaves (learning), and finding new tools or technology. (Just as astronauts use technology to adapt to space.)

Give examples from daily life:

If your house got cold because the electricity went off, how would you adapt? (*Wear a sweater and mittens, or cuddle in a blanket.*)

Animals have adapted in two ways:

- changes in how they behave or act
- changes in their bodies (shape, color, senses, functions, etc.).

In nature, most kinds of adaptations have taken millions of years. Body adaptations often go along with behavior adaptations.

Ask students: “What is the purpose of adapting?” (The answer, of course, is *survival*.)

2. Make three columns on the blackboard underneath three words: *cave*, *bat*, *caver*.
3. Under the *cave* column, ask students to list things about caves that might require animals to adapt. The list should include:
  - darkness
  - wet cave floor and surfaces
  - flying insects
  - cool, steady year-round temperatures
  - hunting animals (predators) on the cave floor (bears, mountain lions, cave rats, other mammals)
  - scarce food in the cave.
4. Under the *bat* column, ask students to list things about a bat’s body and behavior that help it adapt to cave life. The list should include:
  - *big ears* for sonar navigation in the dark
  - *claws* on hind feet and wings, for hanging from the cave ceiling. Hanging from the ceiling keeps bats dry and away from predators.
  - *sharp teeth* for catching insects in the air
  - *wings* — Bats’ long, thin finger bones and thin skin make wings. Flying makes them safe from predators in the cave, keeps them dry, allows them to move easily through cave caverns and passages, and allows them to capture flying insects for food.
  - *fur* to keep them warm in the cool cave
  - *hibernation* — This keeps their bodies from losing too much energy as heat. In the summer, they roost outside the cave.
5. Under the *caver* column, ask students to describe how cavers adapt when they explore caves. The list should include:
  - wearing overalls and boots to prevent cold, wet
  - using helmet lamps for seeing in the dark
  - using ropes and mountain climbing equipment
  - using backpacks for food and drinking water

- learning cave safety to prevent getting lost, getting too cold, having accidents
- carrying first aid kits.

6. Go down the *bat* and the *caver* lists. Decide whether each cave adaptation is a change of behavior (something learned) or body (something that has evolved). Which adaptations are older (a body change developed or passed on over millions of years)? Go over Discussion Questions 1–3.
7. Distribute Handout 7: *Joni Adapts to the Dark*. Go over Discussion Questions 4–6.

### Discussion Questions

1. Troglolobites are animals adapted to living in the cave for their whole lives. What adaptations have cave fish and insects made for cave living?
2. In the bat story, who is better adapted to the cave: the bat, or Jenny and Carlos? (*The Bat. Even with the proper equipment, humans would not survive as long as a bat in a cave.*)
3. Caves can be dark, wet, and cold. Why would animals choose to start living and adapting to a cave? (*Because so few animals have cave adaptations, caves might offer more safety from predators. Cave darkness also hides animals from predators. Because caves have a moderate temperature, they offer shelter from temperature extremes.*)
4. Joni has many adaptations for living in the dark. Which are adaptations of her behavior? Which are tools or technology?
5. How well would Joni do if she got lost in a cave? Would she do better than Jenny and Carlos? Would she do better than cavers?
6. If you became blind, you could go to school to learn some of Joni’s adaptations. You could also get a special dog to help you. Does it surprise you that Joni can earn a living and do so many things?

### New Words

*All grades* . . . . . adapt, behavior, roost

*Grade 1* . . . . . claw, dark, boots, climb

*Grade 2* . . . . . mountain

*Grade 3* . . . . . roost, overall, blind

### Writing Assignment

Write a paragraph about what adaptations you would have to make in your life if you lost your hearing. What problems would you have at school?

# • JONI ADAPTS TO THE DARK •

Joni Colver doesn't look like a bat. She is a pretty woman with short brown hair and a wide smile. In some ways, though, she is like a bat. She doesn't live in a cave, but you might call her a troglobite. Both Joni and the bat have *adapted* to living in the dark.

Joni Colver has been blind since she was a baby girl.

Now, Joni works in a hospital in Nashville, Tennessee. Doctors call her on the telephone. She types their reports about sick people into her computer. Her computer is an adaptation that helps her make a living.

"I'm in love with my computer," she says. Her computer talks out loud to her. It tells her when she makes a spelling mistake. It also helps her to go back in the report and make changes.

Like a bat, Joni's adaptations also help her get around. "My most important adaptation is using my other senses," said Joni.

"I listen to traffic noises to tell me when to cross the street, for instance."

Joni walks with a four-foot white cane in front of her. She taps the cane to check for the edge of the sidewalk. The cane also warns her before she bumps into things.

Joni adapts her touch to help read. She can't see type in books. Instead, she feels *Braille*

with her fingertips. Braille books have dots punched in paper instead of letters. Joni writes by making dots with a special pen called a *stylus*. She might punch 150 dots to write a ten-word sentence.

Joni also uses her touch to tell the difference between dollar bills. She keeps one-dollar bills flat. She folds the upper right corner of five-dollar bills, and folds ten-dollar bills in half. The only problem is that other people don't fold money like she does!

"Another important adaptation is my memory," says Joni. "I have to be really organized, and remember everything I do. If I leave the dishwasher door open and forget, *Baam!* I bang into it."

Joni also adapts with her nose and ears. In a shopping mall, she knows when she's at the cookie store, the radio store, or the leather store. Coming home, she walks through the parking lot until she smells the dumpster. Then she turns left to get home.

Joni does not have adaptations for everything. Her husband must read restaurant menus to her. "And I don't wear makeup," she says. "I wouldn't know what to do with it."

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geology Mineralogy Hydrology Biology Anthropology
<i>Disciplines</i>	Science Reading
<i>Special Skills</i>	Computer

## LESSON 3.3 Let's Visit a Cave

### Activity Summary

We recommend organizing a field trip to a “show cave,” if possible. Barring a real visit, however, students can “visit” a cave in several other ways: books, the Internet, a class visit from a caver or geologist, brochures from show caves, and movies/videos.

### Educational Goals

Students will be able to describe the cave environment in detail.

### Procedure

Choose one or more of the following methods for a class “visit” to a cave:

1. If you live near a “show cave,” arrange an actual field trip. Do not attempt to explore a “wild cave” with untrained students or adults.
2. Read a well-illustrated book.  
(See the List of Multimedia Resources.)
3. Use computer access to visit caves around the world on the World Wide Web. Teachers and students can use Web addresses in the List of Multimedia Resources. Other sites may be located by searches under “caves,” “spelunking,” “speleological,” and related terms.
4. Arrange a class visit by a local cave enthusiast or geologist or other cave expert. Many are avid

photographers and could be persuaded to show slides of their cave explorations. Ask them to bring caving equipment as well (be sure to have students smell coveralls and boots — this will give them a real cave experience).

You can find cavers by:

- (1) Searching Internet member lists, by combining search words “cave” and “spelunking” and “karst” and “speleology” with local geographic names. Some Web services allow members to list their hobbies and interests. (*Caution: teachers should check out these lists themselves. Under “cave,” some people list themselves with erotic descriptions.*)
- (2) Requesting local referrals from the National Speleological Society or a local caving group. (Local groups often call themselves “grottoes.”)
- (3) Calling the geology department of a nearby university or college. Ask for someone studying caves or karst geology.
5. Ask students to write to national, State, and commercial show caves for free flyers and information. Post flyers that arrive on the classroom wall and discuss the differences and similarities among the caves.

## Chapter 4: Water and Cave Sculptures

Jenny and Carlos felt refreshed from their lunch break in the Bateteria. They scrambled up a pile of loose slippery boulders. At the top, an entrance took them into another cave room.

Jenny moved the flashlight beam about the room. “Look!” she said. Instead of boulders, this room was crowded with those pointy-shaped stone tree stumps that looked like soft ice cream. Only this room was like a forest of the strange rocks. “It’s like a museum of weird sculptures.”

Icicle-shaped rocks hung from the ceiling. On the cave walls, the rocks rippled and draped like curtains. Here and there flower-like crystals grew, while others stuck out like strange spirals of funnel cake you buy at the fair. “It’s magic,” Carlos said. “I’ve never seen anything like this.”

Drops of water hit rock formations everywhere, *drip! drip! drip!*

“Bat,” asked Carlos, “what are those things called, again?”

Bat was resting, hanging upside down from a crystal on the wall. He flew to the icicle shapes hanging from the ceiling. *These are stalactites*, he said. *The ones on the floor . . . those are stalagmites.*

Carlos complained. “Bat, do you have to use such big words? Why are cave words so hard?”

Bat admitted they were hard words. He said that the big words were made up by humans and had been used for a long time. *But the cave explorers use a silly rhyme to remember which is which.*

“Well, tell us the rhyme,” Jenny demanded.

*The stalactite holds tight . . .*

“I know!” Jenny cried. “Hold tight . . . they’re the ones that hold tight on the ceiling! Right?”

*Right. So stalagmites are the guys growing up from the ground. Cute little “mites.”*

Jenny agreed. Some of the stalagmites actually looked like little baby rock formations. The children practiced the rhyme together.

“The stalactite holds tight, and the stalagmite’s a cute little mite.”

With the rhyme in her head, Jenny turned the flashlight beam overhead. She wondered if she would see

another bat colony, but no small shapes were hidden between the rocks. Some of the stalactites looked like soda straws. They were white and hollow, and water dripped down from their tips.

“We should call these soda straw stalactites,” she said to Carlos. Bat agreed. *That’s exactly what the cave explorers call them.*

“Bat, what do you mean the stalactites ‘grow’?” asked Carlos, looking at a big stalagmite in front of him.

“These are rocks, not plants.”

*They grow, but they’re not alive like a plant or animal. They get bigger really slowly. In fact, that stalagmite in front of you probably took ten thousand years to get that big. Just a teeny bit every year.*

“How do they grow if they’re not alive?” Carlos wondered.

*If this was a dry cave, they wouldn’t grow here. But this is a wet cave, with water dripping all the time, said Bat. Each drop of water brings a tiny bit of rock. The rock is dissolved, like sugar is dissolved in your tea. When the water dribbles down the rock, it leaves the dissolved rock behind. The stalactite gets longer, or the stalagmite gets a little taller. The rock formations grow bigger, day by day and year by year.*

*And those soda straws. You can see the drips that fall through all the time. When the water gets to the end of the straw, it leaves some of that dissolved rock on the tip. That’s how the straws get longer and longer.*

“Carlos! Bat! Look here!” Jenny called. “Some soda straws are broken. They’ve fallen to the ground like a broken glass!”

The two children looked at the broken soda straw stalactites. It took thousands of years, Carlos thought. He felt sad to see the delicate rocks destroyed forever. Magic gone.

Bat started fluttering around the cave room. *Flap, flap, flap*, his tiny wing-beats echoed angrily though the cave. He squeaked so fast that they couldn’t understand him. Slowly he calmed down. He finally rested, hanging from the ceiling, his leathery wings drooping, panting little bat pants.

“What’s the matter, Bat?” Carlos asked.

*Sometimes I get so upset at humans. I know there are nice humans like you, but some humans do bad things.*

*I like those soda straws so much, and somebody came in here and broke them. It wasn't the cave explorers, just some other people who wandered in. The cavers are really careful and always take their garbage. Except when they lose something like the flashlight.*

“And it will take thousands of years to grow the soda straws again,” added Carlos. He moved the flashlight beam around the cave.

On the other side of the room, he spotted a small pile of garbage. Together they collected two pop cans, potato chip bags, and plastic sandwich bags.

“Let's take the garbage out, Carlos,” suggested Jenny. “It doesn't belong in a cave.” They put the garbage in their backpacks with their own lunch trash. Jenny looked the area over carefully with the flashlight until they found every last piece of garbage.

“Let's leave this apple core,” whispered Jenny. “It looks like the troglobites were already eating.”

She looked up and gasped. On the wall, the thoughtless visitors had scrawled their names in spray paint. *Freddie and Jane Wur Heer, 1996*, it said. Jenny was shocked. “It's ugly, and they can't even spell right. They made this magical place ugly.” She put her head on Carlos' shoulder. “It's sad,” she said quietly.

“I'm so sorry Bat,” Jenny said. “I'm not going to tell anybody where this cave is after we get back. Will that help?”

*Yes Jenny, it will. It would be better if only cavers came here. Real cave explorers would only tell other responsible cavers. Or tell people if someone was going to build a house on top of a place that would cave in. Then they would tell to prevent accidents.*

Once again, they heard the bat's *flap, flap, flap* as he flew around the cave. *Hey! Let's get moving, he squeaked. We'll be late for supper if we don't get going.*

Carefully they walked between the stalagmites and dodged the low-hanging stalactites. Their good spirits returned. Bat flew toward a shadow where another tunnel led out of the soda straw room. He told them to turn off the flashlight to save energy. Jenny shut her eyes for a moment and gave thanks that they could stand up in this tunnel.

They turned off the flashlight to save battery power. Carefully they walked into the darkness again. As they left the room behind, Carlos wondered to himself: If nobody could see something ugly, did it matter?

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geology Ecology Hydrology Anthropology
<i>Disciplines</i>	Science

## **LESSON 4.1** Follow-up Discussion and Demonstration

### **DISCUSSION**

#### **Procedure**

1. Allow students to color Handout 8: Reading Follow-up Coloring Page. While students are coloring, discuss questions below.

#### **Materials Provided**

Handout 8: Reading Follow-up Coloring Page

#### **Discussion Questions**

1. Can you think of other places where you have seen water acting as a sculptor?  
*(cliffs, river beds, hoodoos, mud slides)*
2. Many cave rock formations take tens of thousands of years to form. Should visitors break or collect cave formations?
3. Why is garbage harmful in a cave?
4. What things besides limestone dissolve?  
*(salt, dyes, sugar, baking soda)*
5. When people paint or write on walls or other things, it's called "graffiti." Do you have graffiti in your community? Discuss.
6. What kinds of damage can people do in caves?  
*(drawing on walls, leaving garbage, breaking rock formation and crystals, collecting rock formations and crystals)* Where on the coloring page is human damage shown?
7. (After crystal demonstration) How could you see crystals growing in a cave? Would crystals grow slower or faster?

### **CLASS DEMONSTRATION**

#### **Materials Required**

- 4–6 cups all-purpose flour
- Water
- Large mixing bowl and mixing spoon

#### **Procedure**

1. Form hard dough with flour and water in mixing bowl. Knead dough until it is stiff.
2. Run water (gently) over the dough. Gradually, the dough ball will get smaller, until only a small nub of sticky material is left. Explain that this is how water dissolves rock formations in the cave, changing both their size and shape.

#### **New Words**

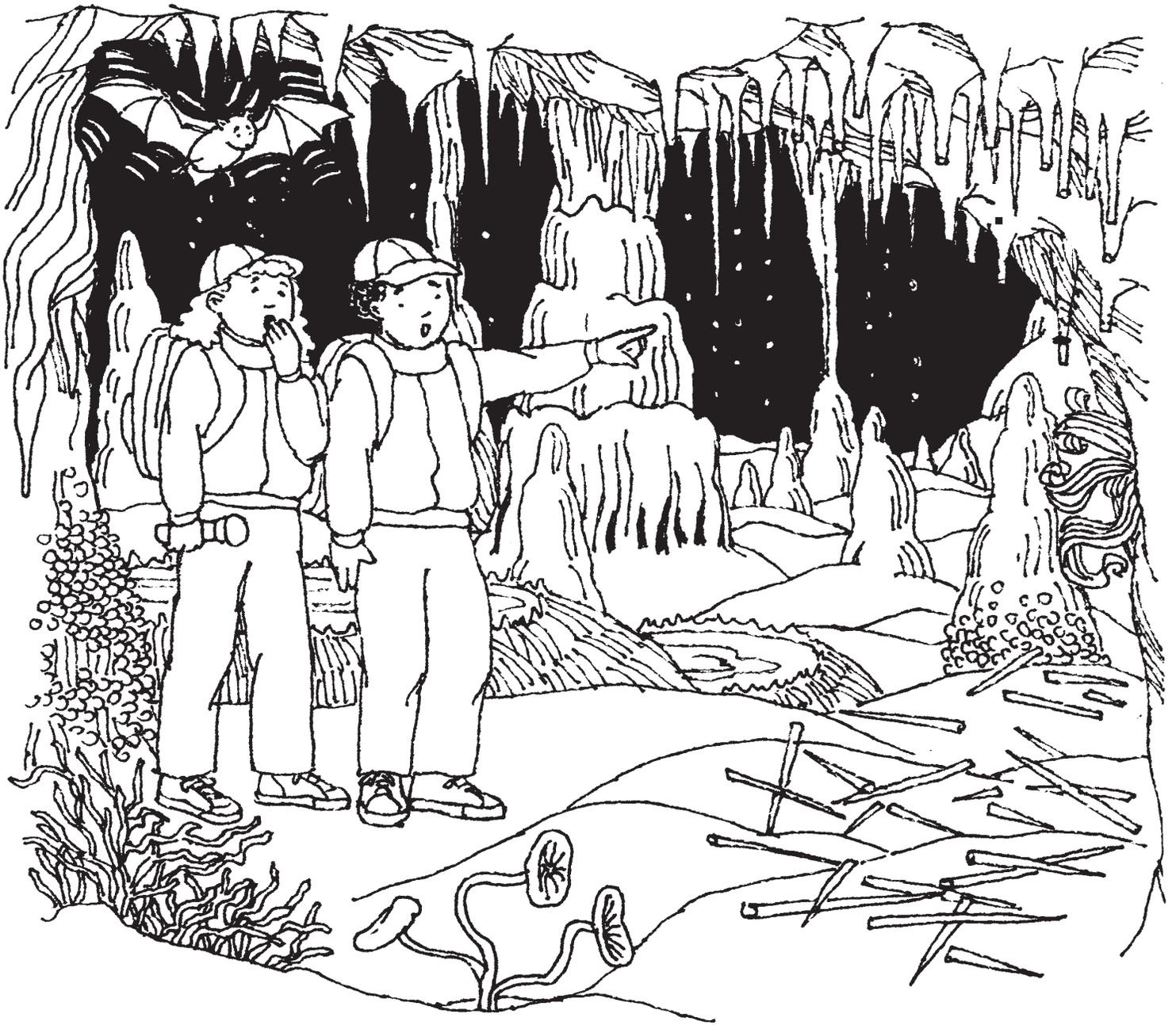
*All grades* . . . . . crystal, dissolve, rock formation, stalactite, stalagmite

*Kindergarten* . . . . . cry, grow, see, sad, soda, straw, bug, dry

*Grade 1* . . . . . joke, paint, sorry, twenty, matter, whisper

*Grade 2* . . . . . tear, whisper, destroy, hungry, destroy, dribble

*Grade 3* . . . . . crystal, hollow, ugliness, dodge, spirits, shadow, sculptor



<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Geology Hydrology Mineralogy Maps
<i>Disciplines</i>	Science Geography

## LESSON 4.2 Water Creates a Cave

### Activity Summary

This activity demonstrates the role of water in limestone cave formation. First, the teacher illustrates the block-like nature of limestone, or karst bedrock. Then, the teacher allows students to “create” a cave on a karst-like grid on paper.

### Teacher Background

Limestone caves are formed in what is called “karst topography” or karstlands. Karstlands consist of limestone bedrock that is fractured into more-or-less rectangular blocks of various sizes. The fractures and blocks are irregular. They may not be continuous in any direction. When water seeps down from the surface, it dissolves limestone along these fractures. The rate of dissolving depends upon how much acid or water is in the rock, and how much acid is in the water. Water is more acidic at levels near the water table.

Some areas of the United States have bedrock close to the surface. In areas of the West and Midwest, land was once covered by glaciers during the ice age. Several hundred feet of gravel may cover the bedrock. Children in these areas may rarely see bedrock, and may have a hard time imagining it.

Karst topography develops many interesting landforms. These include caves (with shafts, tunnels, and caverns), sink holes (where the surface rock layer suddenly collapses into a cave structure), and sinking streams (where a stream or river suddenly disappears underground).

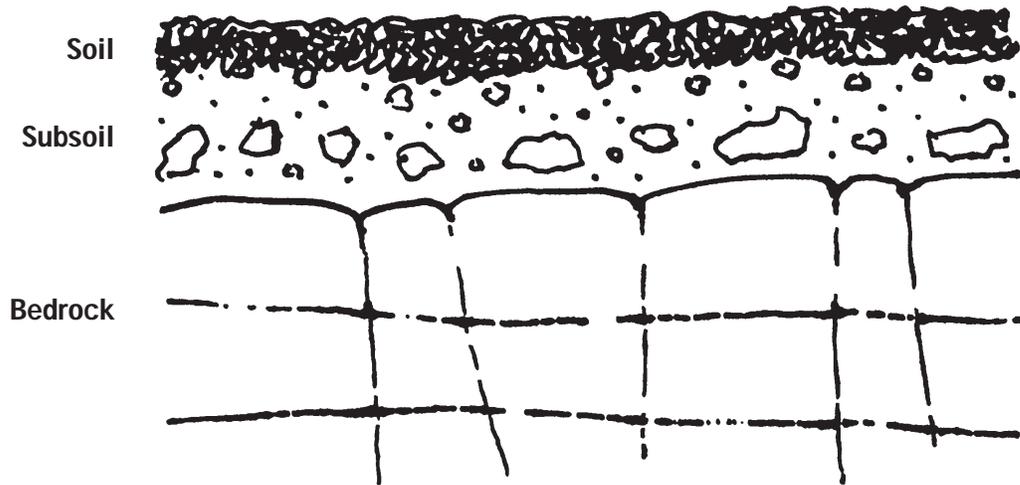
This activity may seem like a lot of work, but it demonstrates the many aspects of limestone quite graphically.

### Materials Required

- Crayons
- Several block sets, preferably of different sizes. (Or, make plaster blocks in ice cube trays to simulate limestone more closely. Make at least 4–5 trays of different sizes.)
- Cookie sheet with side ridges
- Pieces of limestone, large or small
- Quart container of water
- Aluminum foil
- Dish towel

### Procedure

1. Ask students to think about the rocks underneath their school. How far down does the soil go? What’s under the soil? (Ideally, take children into the schoolyard and dig, just to see.) Tell students that eventually, some kind of solid rock is there, called *bedrock*. Draw a profile of soil, subsoil, and bedrock on the blackboard (see next page).
2. Tell students that limestone is one kind of bedrock. Most caves in the United States are in limestone. This activity is about how caves form in bedrock.
3. Use a central desk in the classroom to demonstrate with the blocks. Build a large, solid, block structure on the cookie sheet. (Practice ahead of time.) Some areas of the structure are large blocks, others consist of smaller blocks. Drape a dish towel over the structure, to represent the surface layer — and help hold it together. Tell students that limestone is



something like this structure. Show them a piece of limestone. Millions of years ago, limestone started out as a mixture of mud and seashells at the bottom of the ocean. When it was formed, limestone was in giant blocks. As it dried out, cracks were formed.

4. Ask students to describe the structure. Words that should come up:  
broken, blocks, pieces, different-size pieces, straight lines, chips broken off.
5. Ask what would happen when rain fell on the surface. (*Rain trickles down the cracks.*) Demonstrate by pouring some of the water on the top of the block structure. Students should see water collect in cookie sheet. Explain that in nature, rainwater goes down until it can't go any further. There, it joins the *water table*.

6. Pour more water on the structure. Explain that water dissolves (*like sugar in tea*) limestone slowly and the cracks get wider. (*Spread blocks slightly.*) Near the water table, the limestone dissolves even more. (*Spread blocks and remove one or two without collapsing the structure.*)
7. Ask students to name the hole now created in the block structure. (*A cave.*)
8. Discuss the length of time for a cave to develop (*tens of thousands of years*), and how big a cave can get .
9. Remove some blocks just under the top row of blocks. The top will collapse. Tell students that this is a *sink hole*. Invite students to "make caves" with the blocks if spare time is available. Demonstrate a sinking stream using an aluminum foil stream bed, with water simply disappearing into the blocks.

## Chapter 5: Caves Guard the Past

Jenny saw it first.

“Light!” she cried as she saw the end of the tunnel. “Are we out of the cave, Bat?”

*No. Look over your head, Jenny,* said Bat.

Jenny looked up. Way, way up she saw a hole, and daylight was streaming through it. It was just a sliver of light but so bright that Jenny and Carlos had to squeeze their eyes shut.

Carlos looked up suspiciously. The cave narrowed above them into a tube with a hole at the top. It went up hundreds of feet. “Do we have to climb out that hole?” she asked fearfully.

*Well, did you bring any mountain climbing equipment?* asked Bat.

“Oh sure. Like Batman?” laughed Carlos.

Then it was Bat’s turn to laugh. *I’m serious, he squeaked. Lots of cave explorers carry ropes and things. They have to for places like this. But they don’t climb here. It’s one of those places where the top of the cave is dissolving away. It’s called a sink hole and it’s going to cave in one of these days. It’s dangerous here, so we’re going out of the cave a different way. Sorry. It’s through another tunnel.*

Bat led them into a skinny, dark, twisting tunnel. They turned off the light to save energy again. “You know Jenny, we’re getting pretty good at this. We’ve learned to use our arms to feel around, and we’re not so scared,” said Carlos.

“It’s amazing, isn’t it,” agreed Jenny as she felt the tunnel wall with her fingers. Soon, they sensed they were in one more cave room. They could tell by the way their voices echoed. Even without seeing, they could guess it was another large cavern.

They begged Bat for a rest stop. Jenny switched on the flashlight again, and moved the beam across the walls.

“Stop Jenny, look back there!” Carlos pointed to the wall. The flashlight lit up a series of pale figures. The two friends stared. A row of eight dark hand prints appeared on the wall. They looked like finger print figures made of dark clay or mud. On the left were the smallest prints — a child. On the right, adults had left larger marks.

“Whose hands were those?” Jenny wondered. “Was it the people who sprayed the wall and broke the soda straw stalactites?”

“I don’t think so Jenny. Look over there.” Carlos pointed. “Animal paintings. These things are old.”

Jenny studied the paintings, beautifully outlined in black. She agreed. It looked as if the artists had drawn the pictures with the ashes of a campfire, long, long ago. She could almost hear their voices in the cave.

A buffalo, in soft brown and orange colors, commanded the wall. Below the buffalo, a deer with antlers leaped high. It was badly wounded, with three arrows in its chest.

“Indians,” murmured Carlos. “Maybe these are the same tribes that we studied about in school, like the really old people they found in Mammoth Cave.”

They looked again in silence. They forgot all about the bat, who suddenly flapped over their heads.

*Thank you! Thank you!* the bat squeaked. *I’ve lived in this cave all my life and have never seen these pictures. If you hadn’t come with the flashlight, I would never have actually seen them. Thank you!*

The two children looked up at Bat, pleased and surprised. They felt happy that they could give something back to this little animal who was saving their lives. Bat hung on a rock overhead, looking at the pictures.

Together they stared at the ancient pictures. Why did these people come to this cave? Perhaps it was warm here in the winter, and cool in the summer. Did they live here all the time, or just in bad weather? Were the hand prints a family? Or members of a tribe? What happened to them?

Jenny spread her fingers near the smallest print, afraid to touch it. She held her hands in the air, matching thumb to thumb, pinky to pinky. Her hands were just a little bigger than the prints. Was this a boy, like Carlos? Or a girl, like her? If so, how old was she? What was her name?

Carlos looked at the animals. He saw the arrows in the deer’s chest, and even a line showing blood. These were hunting people. Did they hunt that huge buffalo too? Did they say prayers to the animals they hunted? Carlos had read about that before.

“Bat, how old are these Indian things?” Jenny asked.

*Oh I don't know. I bet thousands of years, Bat squeaked.*

“But why haven't the cave explorers found these things, Bat?”

*They might have, and they were careful not to touch or destroy them. But maybe they couldn't get in here because they were grown-ups. You kids got through that skinny tunnel more easily. It's pretty small for grown-ups. I bet those people from long ago were really small, too.*

The children were silent for a moment. Bat was telling them that they had just made a discovery. Probably no other people in modern times had seen these pictures. Even Bat hadn't seen them.

Jenny sat down near the paintings. She shone the light around the cavern. On one wall, the Indian paintings seemed to call to her from the past. In the rest of the cavern, crystals and rock formations gave the feeling of hidden jewels and lost treasures. For a moment, she felt almost happy in the cave.

The Bat *flap, flapped* overhead for a minute.

Carlos looked worried. “You know, I really want to tell my friends about this cave. But if I do . . .”.

“Yeah. I wonder about that too,” Jenny admitted. “I don't want people to come here and ruin the cave. I mean, what would we have done without the bat? We might have gotten lost, or made a mess, or accidentally broken the soda straws.”

Bat settled on a stalactite overhead. *There's one solution. Find a caver group at home. Join up and learn how to be a caver. Then you'll do it right. And you can tell people about this cave if they know how to do it right. I learn a lot from cavers.*

The Bat then ordered the children to turn off the flashlight.

*Lights out, heads down. Go to your left, one last tunnel.*

Whispering goodbye to the mysterious hand prints, Jenny led the way into the tunnel on her hands and knees. This time the tunnel twisted and turned, taking the occasional hump or valley. Now and then they could hear the bat bump into the wall around sharp corners. Many other tunnels branched off. Without the bat's squeaky instructions, the children knew they would never get back to camp — or find their way back in. Jenny almost believed that Bat was taking

them into this tunnel so that they'd never find their way back.

At last, Jenny spotted a glimmer of light shining on the tunnel wall.

“We're almost out, Carlos!” she shouted.

Bat squeaked with excitement. *It's mosquito time! Mosquito time! Sun's down, bugs up, and bats bite!*

At last they stood at the cave entrance. Carlos wondered just how many openings there were. The rain had stopped and the sky had darkened as the sun began to set. The cave entrance was hidden behind tall bushes. The camp was at the bottom of the hill. But nobody could see Jenny and Carlos because of the bushes. Campers below were lining up at the dining hall for supper.

Jenny looked up at Bat, hanging from a rock. “Thanks for saving us, Bat. Carlos and I will keep your secret. We'll just tell people that we got lost and fell asleep under a big rock. I hope they haven't worried too much.”

“And we'll come back some day with a caver's group. We'll be too big to get in that last tunnel,” Carlos added.

*Thanks kids. Now get yourself back to camp. I'll fly over your campfire tonight. Look for me.*

With that, the children pushed their way through the bushes and ran down the hill to camp. Behind them, Bat began to zoom through the cloud of bugs that hang around cave entrances. He couldn't remember when he'd been this hungry.

Later that night, Carlos and Jenny sat with the other campers around the camp fire. While everyone else was slapping mosquitoes, the two friends stared into the night sky. The afternoon's adventure seemed too fantastic to be real. But still, they wondered which of the bats, swooping like great black butterflies overhead, was their Bat.

They worried a bit. Had Bat used too much energy in helping them? Did he catch enough mosquitoes? Was he OK after helping them?

Just then they heard a familiar squeak just behind their heads. Soft leather wings brushed past their cheeks.

*Good night, Jenny! Good night, Carlos!*

The two friends smiled at each other.

“ ‘Night, Bat.”

<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Anthropology Biology Mineralogy
<i>Disciplines</i>	History Geography Art

## **LESSON 5.1** Reading Follow-up Activities

### **Materials Provided**

Handout 9: Reading Follow-up Coloring Page

### **Procedure**

1. Distribute Handout 9: Reading Follow-up Coloring Page.
2. While students are coloring, talk about Discussion Questions, below.
3. Incorporate New Words into writing and vocabulary lessons.

### **Discussion Questions**

1. Many caves have become National Parks. Can you explain why?
2. Why would people long ago use caves?  
*(Caves provide shelter from enemies, and from bad weather in the summer or the winter, and provide certain mineral resources.)*

3. Many pictures and art from ancient peoples have been found in caves. Why would this be?  
*(No plants grow in caves, and leaves would not cover the remains. Also, dry caves preserve bones, bodies, and art.)*
4. Both ancient art and street graffiti are similar. They are both drawn on walls or rocks. How are they different?

### **New Words:**

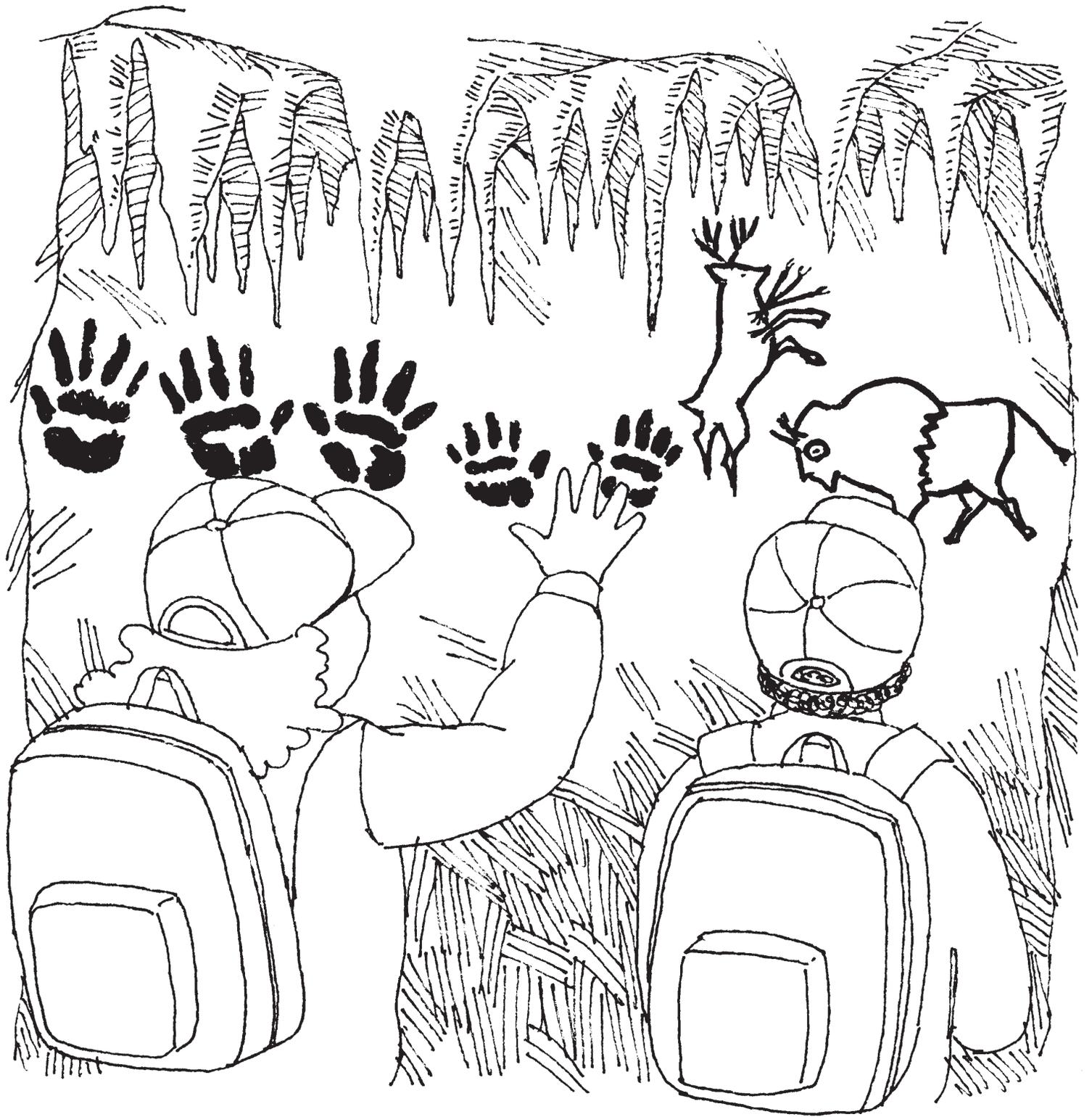
*All grades* . . . . . sink hole

*Kindergarten* . . . . art, deer

*Grade 1* . . . . . paint, discover, campfire, buffalo

*Grade 2* . . . . . hunt, arrow

*Grade 3* . . . . . mosquito, guardian, ancient



<i>Grade Levels</i>	K, 1, 2, 3
<i>Science Topics</i>	Anthropology Biology
<i>Disciplines</i>	Social Studies Art

## **LESSON 5.2** Cave Art and History

### Activity Summary

This activity gives students a sense of the creative background for ancient cave art. If possible, teachers should enrich the activity with references or Internet materials showing cave art in the United States or Europe.

### Educational Goals

Students will be able to:

- Name three ways that humans have used caves.
- Give two possible interpretations for cave art depicting animals.
- Name two possible reasons for ancient cave art.

### Teacher Background

Prehistoric cave art inspires us today, even centuries later. Somehow, artists of old can still communicate with us through their simple, monumental rock paintings. In this activity, your students will get a feeling for both making and viewing such art.

If you have Internet access, explore Web pages with search phrases such as “cave AND art” or “cave AND paintings.” Internet addresses can change unpredictably, but at the time of publication of this teaching guide, Web pages with graphic cave images include:

<http://www.culture.fr/culture/gvpda-en.htm>

[http://www.aquarel.fr/region/Lascaux/salle\\_des\\_taureaux/salle\\_des\\_taureaux.html](http://www.aquarel.fr/region/Lascaux/salle_des_taureaux/salle_des_taureaux.html)

Both sites illustrate French cave painting discoveries, including the recent ones at Vallon-Pont d’Arc. French caves have revealed some of the world’s most awesome cave art. Animal depictions may have been

the artists’ way of keeping records of animals that they had killed. Why the Cro-Magnon artists drew in caves remains a mystery. Some cave paintings are 25,000 years old.

Many Web sites showing Asian caves are full of exciting art also, but much of it is of an erotic nature and not suitable for young students.

In America, the caves of the Anasazi tribes, in the southwest, and Mammoth Cave, in Kentucky, offer impressive prehistoric art. Mammoth Cave is the site of four-thousand-year-old objects, including spoons and moccasins. There is evidence of gypsum mining. Gypsum and other minerals were probably used for body paint, and perhaps for seasoning and medicine.

Cave art is not surprising, when one considers the many ways that humans have used caves over the centuries. These uses include religious worship, storage, mining, and burial. In some parts of the world, entire communities live in caves today, as the Anasazis did in the past.

American history has many stories about caves. Along the route of the Underground Railroad, slaves took shelter during the civil war. Desperado Jesse James is thought to have hidden \$100,000 in gold coins in a Missouri cave. Other people have used caves for producing nitrates for gunpowder and fertilizer. Food producers have used caves for cooling chickens and aging cheese.

Over the years, both children and their dogs have played an important role in cave discovery, including the sites of major cave art. Why? Partly because both children and dogs are naturally curious and love to explore. Both are also small. Like Carlos and Jenny in

the story, children and their pets can squeeze into small passages.

If your class lives in cave country, or travels in cave country, it is important to emphasize the danger that caves present. Children need to realize that if they find caves, they should not explore them by themselves. Even adults should not explore wild caves except in the company of trained cavers.

### Materials Required

- Colored chalk
- Newsprint
- Finger paints or poster paint (large jars)

### Procedure

Show the class pictures of cave art from books, Internet, etc.

Choose one of the following approaches:

#### 1. Blackboard as cave wall

Invite students to draw one object on the cave wall.

Trace children's hand prints in chalk, color in.

Draw an animal that a prehistoric hunter might hunt (deer, rabbit, mammoth, etc.)

#### 2. Newsprint as cave wall

3. Personal rock art — ask students to bring a smooth rock to school. Ask them to paint rock art on their stone.

Invite students to contribute one piece to the cave wall. Same objects as above, but use brown finger paint or thick poster paint. Create a mural.

### Discussion Questions

1. Why did people make cave drawings?

*(Tell stories, keep records, represent religious events, worship.)*

2. Why did ancient people choose caves for their art instead of other places?

*(To keep pictures secret, to shelter from bad weather, good surfaces for drawing.)*

3. In what ways are cave drawings like television, magazines, or newspapers?

*(Pictures tell stories and record history.)*

# List of Multimedia Resources on Caves

## Books and Stories for Children

---

Baumann, Hans, *The Caves of the Great Hunters*, Pantheon Books, 1954. 182 pages. Although old, this delightful story fictionalizes the role of children in discovering the great Ice Age cave paintings of Dordogne, France. The book reproduces the paintings as charming line drawings.

Coder, K., Taylor, A., Molosky, A., *Pennsylvania's Caves & Caverns*, 1989. 32 pages. Word games and other activities.

Connon, Jenell, *Stellaluna*, Harcourt, Brace, and Company, 1993. 48 pages. The tale of a young fruit bat and her mother. Winner of American Bookseller's Book of the Year Award. For all ages.

Cooper, Ann C., *Bats: Swift Shadows in the Twilight*, Denver Museum of Natural History, 1994. 64 pages. Unique activities and illustrations. Could be used for teaching activities.

"Getting to Know Bats," "A Pocketful of Science," and "Brushing Up on Bats," *The Primary Mailbox*, The Education Center, Inc., October/November 1993. Activities and crafts.

Hamilton, Elizabeth, *The First Book of Caves*, Franklin Watts, Inc., 1956. 61 pages. An oldie-but-goodie, if you have an older library.

Jennings, Jan F. G., *Bats: A Creativity Book for Young Conservationists*, undated. Bat Conservation International. 30 pages. A craft and activity book.

Kerbo, Ronald C., *Caves*, Children's Press, 1981, 48 pages. Cave formation and caver activities.

Lundberg, Kathryn T., *Bats for Kids*, Northword Press, Inc., for National Wildlife Federation, 1996, 48 pages. Photos and drawings of many bat species in action.

McClury, James E., *Caves and Their Mysteries*, Whitman Publishing Company, 1962.

Menzies, Elin, *Taking Katy for a Nightride*, Blue Cat Press, 1991. 20 pages. Easy reading.

Milton, Joyce, *Bats, Creatures of the Night*, Grossett & Dunlap, Inc., 1993. 48 pages. Colorful cutout illustrations of bat life and facts. Early readers.

Mohr, Charles E., Poulson, Thomas L., *The Life of the Cave*, Our Living World of Nature, McGraw Hill, 1966. 232 pages. This book, if you can find it, is probably the best all-round description of the cave environment for young readers and adults.

Rigby, Susan, *Caves*, Troll Associates, Our Planet Series, 1993, 32 pages. Cave geology and biology, as well as section on cave legends and human use.

Schultz, Ron, *Looking Inside Caves and Caverns*, John Muir Publications, 1993. 46 pages. Spectacular photographs, good coverage of cave safety and the different kinds of caves.

Schwartz, Douglas W., *Prehistoric Man in Mammoth Cave*, Interpretive Series No. 2, 1965, Eastern National Park & Monument Association, 1965. 28 pages. Prehistoric cave-dwelling Woodland People, of Mammoth Cave.

Silver, Donald M., *One Small Square Cave*, Scientific American Books for Young Readers, W.H. Freeman and Company, 1993. 50 pages. Comprehensive, well-illustrated book.

Toops, Connie, *Let's Explore Caves and Caverns*, Explorer Press, 1990. Activities, stories.

Twain, Mark, *Tom Sawyer*. Tom Sawyer has part of his adventure in the limestone karst of McDougal's cave. Worth revisiting.

Wood, Jenny, *Caves*, Puffin Books, 1990. 30 pages. Photos, activities, true stories.

Zim, Herbert S., *Caves and Life*, William Morrow and Company, 1978. 64 pages.

## Reference Books

---

Chapman, Phillip, *Caves and Cave Life*, Harper Collins, London, 1993. 220 pages. A look at British caves, their natural history and history.

Gurnee, Russell and Jeanne, *Guide to American Caves, A Comprehensive Guide to The Caves in the United States Open to the Public*, R.H.Gurnee, Inc., Closter, N.J., 1990. 288 pages. An illustrated, comprehensive guide to U.S. show caves, both public and private. You can find the nearest caves to your community in this publication.

Moore, G.W., Sullivan, G.N., *Speleology: The Study of Caves*, Cave Books, St. Louis, Mo., 1964, 1978. 150 pages. Excellent, all-round reference. Intriguing etchings.

## Music

---

Mendelssohn, Felix. *Fingal's Cave Overture*.

Meyer, Billy, composer; Susan Tomes, pianist. *Loose Elbows*, Track 1, "Bats in the Belfry," 1989 Virgin Classics CD # VC7 90745-2. A light-hearted piano instrumental number. Good for background music during art activity or dance.

## Articles and Special Publications

---

American Printing House for the Blind, 1839 Frankfort Avenue, Louisville, KY 40206. Telephone: (800) 223-1839. Publishes small wallet-size cards containing the Braille alphabet.

Crumpton, Ben, "Turning 'Can't' Into 'How,'" *Disability Today*, Spring 1996, pages 10–12.

Howard, Alan D. and Groves, Christopher G., "Early Development of Karst Systems 2. Turbulent Flow," *Water Resources Research*, v. 31, no. 1, January 1995, pages 19–26.

Jennings, J.N., "Karst Landforms," *American Scientist*, v. 71, November–December 1983, pages 578–586. Since 20 percent of the Earth is covered by limestone karst, it's worth studying the history of the landforms.

Palmer, Arthur N., "Origin and Morphology of Limestone Caves," *Geological Society of America Bulletin*, v. 103, pages 1–21, January 1991. A technical classic in the field.

Poulson, Thomas L., White, William B., "The Cave Environment," *Science*, September 5, 1969, v. 165, no. 3897, pages 971–1165. A good overview of the evolution of cave animals.

*Rand McNally Atlas of World Wildlife*, "Prisoners of the Dark," (Europe) pages 94–95.

U.S. Department of the Interior, Geologic Inquiries Group, U.S. Geological Survey, *Selected References on the Geology of Caves and Related Topics*, 1991. 8 pages. Geologic Inquiries Group, 907 National Center, Reston, VA 22092. Telephone (703) 648-4383. References organized into Caves by States and Large Regions, General Information on Caves and Spelunking, and Geology of Caves. Useful for information about caves in your area. Worth ordering well ahead of the time you plan to teach this unit.

U.S. Geological Survey, U.S. Department of the Interior, *Geology of Caves*, GPO: 1991 O-307-567: QL 3, 20 pages. Pamphlet, available from Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Box 25425, Denver, CO 80225.

Waller, Roger M., *Ground Water and the Rural Homeowner*, U.S. Geological Survey, U.S. Department of the Interior, 37 pages. A general survey of ground-water issues, many of which apply to caves and cave formation.

Watson, Richard A. and White, William B., "The History of American Theories of Cave Origin," *Centennial Special Volume 1*, Geological Society of America, 1985, pages 109–123. A history of U.S. geological thought on karst limestone development.

White, William B., Culver, David C., Herman, Janet S., Kane, Thomas C., Mylroie, John E., "Karst Lands," *American Scientist*, v. 83, September–October 1995, pages 448–459.

## Teaching Materials

---

*Educator's Activity Book About Bats*, Bat Conservation International, 1991. 60 pages. Extensive teacher background and activity suggestions on bat and conservation topics. (See World Wide Web Pages for Internet address.)

*Project Underground: A Natural Resource Education Guide*, Project Underground, Inc., 1996. Available from Carol Zokaites, National Director, 620 McDaniel Drive, Christianburg, VA 24073. Phone: (540) 381-8234. K–12 curriculum guide. 120 pages.

*USGS Learning Web*. See World Wide Web Pages.

## Organizations

---

Bat Conservation International, Inc., Post Office Box 162603, Austin, TX 78716-2603. Free brochure, bat box instructions.

National Speleological Society, Inc., 2813 Cave Avenue, Huntsville, AL 35810-4431. Telephone: (205) 852-1300. Association of sport cavers and cave conservationists. Active in promoting cave safety, conservation, photography, mapping, etc. Youth activities included. Free cave safety, preservation, and organizational brochures.

National Caves Association, 4138 Dark Hollow Road, McMinnville, TN 37110. Telephone: (615) 668-3925. Organization of U.S. show caves. Free illustrated brochure and national directory.

## World Wide Web Pages

---

*Note: URL's (Web site addresses) often change unpredictably. If any of the given URL's fail to work, do searches with names of organizations combined with relevant key words.*

<a href="http://www.usgs.gov.education.index">http://www.usgs.gov.education.index</a>	The U.S. Geological Survey (USGS) Learning Web offers teaching materials to supplement activities on mapping, geological landforms, volcanoes, etc. Rich materials with dramatic photographic illustrations.
<a href="http://www.batcon.org">http://www.batcon.org</a>	Bat Conservation International homepage. Extensive database of information on bats, bibliography, teaching materials, articles, even bat sounds.
<a href="http://www.batcon.org/topedu.html">http://www.batcon.org/topedu.html</a>	Educator's Activity Book About Bats (from Bat Conservation International). Teaching activities.
<a href="http://www.caves.org/~nss/">http://www.caves.org/~nss/</a>	This is the home page of the National Speleological Society, with links to related topics.
<a href="http://www.cueva.com/slang/shtml">http://www.cueva.com/slang/shtml</a>	An irreverent dictionary of the terms and slang words used by recreational cavers. Colorful. Edit first before giving students the material.
<a href="http://www.hum.amu.edu.pl/%7Esgp/spec/links.html">http://www.hum.amu.edu.pl/%7Esgp/spec/links.html</a>	Links to caves on every continent.
<a href="http://www.svis.org/comcaves/usacave.htm">http://www.svis.org/comcaves/usacave.htm</a>	Links to commercial caves and show caves in State and national parks. Information (no photos) only.
<a href="http://www.goodearth.com/showcave.html">http://www.goodearth.com/showcave.html</a>	This site shows the location of show caves by State.
<a href="http://www.goodearth.com/virtcave.html">http://www.goodearth.com/virtcave.html</a>	This site has excellent photographs of cave interiors.
<a href="http://www.genlime.com/">http://www.genlime.com/</a>	Genlime Group L.P. This product catalogue of a rock processing company illustrates the many commercial products of limestone-related rocks.
<a href="http://www.muskingam.edu/~ericlaw/courses/geol302/g302_wko7/barta_ls.html">http://www.muskingam.edu/~ericlaw/courses/geol302/g302_wko7/barta_ls.html</a>	This site provides technical descriptions (somewhat academic) of different kinds of limestone minerals.
<a href="http://www.rschp2.amu.edu.au:8080/cave/cavelink.html">http://www.rschp2.amu.edu.au:8080/cave/cavelink.html</a>	This site features worldwide caving sites, information about caving techniques, articles, exploration reports, and particular caves.
<a href="http://techpkwa.cartin.edu.au/interests/speleol">http://techpkwa.cartin.edu.au/interests/speleol</a>	This site provides the In World Conservation Union's (IUCN) Guidelines for Cave and Karst Protection. The preface explains why human uses are endangering caves and karst landforms.
<a href="http://www.kern.com/-ericfoss/blind/bonfbind.htm">http://www.kern.com/-ericfoss/blind/bonfbind.htm</a>	National Foundation of the Blind. Catalogs of products for the blind, from computers to Braille-embossed chocolate bars. Useful for exploring topic of technological adaptation.
<a href="http://www.sources/history.html">http://www.sources/history.html</a>	One-page history of Braille.