

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-oh-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.

