Introduction

Caves are dark, mysterious, adventurous, threatening, romantic, and awe-inspiring. They are home to pirates, treasures, devils, demons, bats, and gnomes. They lead to China, the inner earth, other dimensions, and lost civilizations. Caves have been explored by Orpheus, Merlin, Tom Sawyer, Tarzan, the Hardy Boys, and Batman. In short, caves have fascinated children and adults for centuries. They still do.

The truth about caves is as interesting as their role in fiction and legend. They are inhabited by strange and uniquely adapted life, and they abound with geologic treasures. Moreover, caves are a gateway to the past, to the lives of ancient man and extinct animals.

Modern cave explorers mix science with adventure. In so doing, they have revealed a hidden land with important lessons about the future of our own, sunnier home. By studying caves, you can join in the adventure and become a part of a challenging voyage of discovery. Like our oceans and rainforests, our underground world is just beginning to be really explored. It holds the promise of revealing new materials, medicines, and the processes that could radically better our lives.

Caves are small, self-contained environments with relatively few (and often oddly specialized) inhabitants. They hide rare and beautiful minerals and carry precious water through the earth. Caves provide a home to man and a storehouse of ancient art and artifacts. All these things make caves an ideal vehicle for learning about science and the intricacies of our animal, vegetable, and mineral world.

—Albert A. Kruse, Conservation Committee of the National Speleological Society

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The large format film, Journey Into Amazing Caves, is appropriate for all intermediate grades (4–8). This teacher guide will be most useful when accompanied by the film, but it is a valuable resource on its own. Teachers are strongly encouraged to adapt the activities included in this guide to meet the specific needs of the grades they teach and their students. All activities developed for this guide are consistent with the National Standards for Science, Geography, Math, and English but are not referenced specifically within those standards and use terms consistent with those standards.

Journey Into Amazing Caves
MacGillivray Freeman Films
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The power and scale of IMAX® cinematography reveals the magnificence of one of earth’s most precious and spectacular environments —caves. Journey Into Amazing Caves takes audiences to unusual cave environments, places most people will never experience firsthand. Journey Into Amazing Caves also is an exciting action-adventure story. We follow two young modern-day cavers, Nancy Aulenbach and scientist Hazel Barton, on their dangerous explorations in icy chasms and in dark, underwater passages. The first scene surprises us. We are not underground in a cave; we are flying over the Arizona desert near the Grand Canyon. We see two tiny specks, mere dots on a red wall limestone cliff. Here we meet Nancy and Hazel, descending the precipice to the mouth of a cave high above a winding, turquoise-bad river. To get to this canyon cave, Hazel and Nancy hiked from the plateau above, and then rappelled 300 feet (91.4 meters) down the sheer cliff in 112° F (48.9° C) heat.

Nancy and Hazel are part of a small team exploring the unmapped caves of this remote canyon. Hazel, a Ph.D. microbiologist, searches for organisms that could point to new antibiotics that could cure human illnesses. All caves are alive and support life in surprising abundance. Newly discovered extremophiles—organisms that survive in extreme environments—can exist in absolute darkness, subsisting on few nutrients, sometimes even on minerals! Because...
where the chains remain broken. Aerials and shots
Extreme Life Forms Chart

To compensate, Dr. Hazel Barton spots a cave fish while swimming in an underwater cave in Mexico’s Yucatan Peninsula. Extreme environments force species to total darkness has gradually made this species of fish blind.

To film in five different locations within a canyon requires creativity and innovative planning. In CAVES, MacGillivray Freeman Films, producers of such films as DOLPHINS, ADVENTURES IN WILD CAVEFISH, and EYESTORM, worked day and night to make the shots as they did filming them. In five different locations within a canyon, required 30 people and 3½ tons (3,500 kilograms) of gear, all of which had to be flown in and out by helicopter each day. Spacecraft® aerials and shots from a 20-foot (6-meter) truss rigged to the cliff face made filming a challenge. Logistically, this was probably the most complex shoot the company has ever achieved. Sound like an impossible mission? In fact, the man rigging the shots in some of the scenes for CAVES, did indeed oversee the safety of Tom Cruise in Mission: Impossible. Impossible?

Ice Caves
Next, we follow the women to a glacier on the Arctic Circle. Frenchman Janot Lamberton, a career in the nastiest neighborhoods.” Ice caves form when melting surface water encounters a halocline. Halocline is the blurry layer where fresh water from the underground river floats on salt water from the ocean. They meet but they don’t mix well, creating an eerie, shimmering sight on the giant screen. As a distinct boundary between two extremes, an interface of light and darkness, the halocline must support life forms that don’t exist anywhere else. Hazel is anxious to get samples from the intact halocline—where the cavefish remains unrebuked. In their search for the halocline, the women also explore Jaguar Cave. Without light from the sun, an interesting array of species has developed; their senses have adapted over time to this extreme environment. As the cave narrows, Hazel accidentally kicks up a Blizzard of silt, temporarily causing her to lose her way. A little shaky, but still eager to continue, she says, “That silt-out definitely woke up my dragon.”

In the end, Hazel and Nancy’s explorations will contribute valuable information to our knowledge about caves and the creatures that live there. For some, discovery is the ultimate prize. For others, like Nancy and Hazel, the search itself is its own reward.

The Filming of Journey Into Amazing Caves

Filming in IMAX® requires creativity and innovative planning. In CAVES, MacGillivray Freeman Films, producers of such films as DOLPHINS, ADVENTURES IN WILD CAVEFISH, and EYESTORM, worked day and night trying for the shots as they did filming them. To film in five different locations within a canyon, required 30 people and 3½ tons (3,500 kilograms) of gear, all of which had to be flown in and out by helicopter each day. Spacecraft® aerials and shots from a 20-foot (6-meter) truss rigged to the cliff face made filming a challenge. Logistically, this was probably the most complex shoot the company has ever achieved. Sound like an impossible mission? In fact, the man rigging the shots in some of the scenes for CAVES, did indeed oversee the safety of Tom Cruise in Mission: Impossible. Impossible?

When an animal gathers food, for example, is one that will definitely affect its survival. Bears living in the forest have developed long claws to help them dig roots to eat. Adapting to an animal’s hair, feather, or fur color can aid in survival if the environment changes seasonally. Some species of rabbits turn white, camouflaging them in the winter snow.

To Do: Brainstorm names of animals and their characteristics that enable them to catch food, move around, and protect themselves from predators. Each of these characteristics is an adaptation that animals have developed over the years to ensure their survival.

Have students review the Extreme Life Forms Chart (page 16). All of the animals that are listed on the page are actually found living in or around caves. Add animals and adaptations generated from the brainstorming session to this list.

Using the list, ask students to work independently to design and draw an animal with four to six of the adaptations listed. Creativity is a must for this activity! Encourage students to create the strangest animal possible, with odd combinations of adaptations. Make sure that students can explain their creation to the class and be able to discuss the adaptations and their importance to that animal’s survival.

Ask students to write a description of the animal, including its name (a creative one!) and the purpose of its adaptations. Display the animals and descriptions around the classroom.

What’s Going On & Why? While the imaginary animals created by students in this activity would not be found in local caves, the idea that the adaptations may allow a strange animal to live uniquely in an environment is important. Fish who have lived in dark caves for many years, for example, have adapted so they need no eyesight. Some species do not even develop eyeballs at all! This adaptation seems bizarre unless you look closely at where the animal lives and how it has successfully adapted to its particular environment.

Note: This activity was adapted from materials developed by Project Underground and was used with permission.
Hungry for Survival

Objective: Students will play the part of cave dwelling animals as they experiment with a food web ecosystem.

In The Film: Nancy Aulenbach and Hazel Barton work as a team to gather evidence of microscopic life that lives deep within the earth’s surface. These small organisms may not be what most think of as traditional cave dwellers but serve to illustrate that there is much we do not know about caves and their inhabitants.

Materials:
- Large chart paper and markers
- Chalkboard and chalk
- Copies of Food Cards (page 5)
- Large room or outside space
- Scissors
- Optional: Photos or drawings of animals listed in this activity

Teacher Prep Notes: Prepare for the activity by copying and cutting out food cards to match the following guide: For a group of 30 students make sure you have approximately 80 cards (10 nut & seed cards, 15 cave insect cards, 20 detritus cards, 10 shrimp cards, 10 fish cards, and 15 bat cards). Notice: Laminating the cards to preserve them for future use.

Activity:
- This activity should be conducted outdoors or in a large indoor space.
- Background: Organisms living in caves have adapted to survive in an ecosystem with unique conditions. Extreme darkness, cramped spaces, and smaller numbers than aboveground counterparts make living in caves a challenge. Adding to the challenge is the delicacy of the food web connecting one cave dweller to another.

Food web:
- In these food webs, the survival of each member is dependent upon the survival of the rest of the members. Due to the specialized conditions found inside the cave, the entire food web of cave inhabitants is in constant danger of being destroyed. Pollution created by humans plus the destruction of cave environments often pose the biggest threats to the delicate balance of the subterranean ecosystem. In some cases, if one cave-dwelling species is harmed, the rest of the ecosystem’s plants and animals are at risk of becoming endangered.

To Do:
- Copy the chart (on right) onto a whiteboard or chart paper. To form teams, have students count off 1-5 and assign each team an animal from the following list and place the animal name on the large chart at the appropriate locations.
- Team 1 Wood/Pack Rat
- Team 2 Cave Shrimp
- Team 3 Cave Fish
- Team 4 Cave Crayfish
- Team 5 Cave Salamander

Food Cards:
- Some of the animals listed in the chart can only eat certain things and if they cannot get enough of the proper food types they will not survive. The organisms listed on the chart are members of a cave food web. The animals listed can eat only the indicated plants or animals on the chart.

Move the group to a large outdoor area and have students stand in a circle. Place the prepared food cards picture-side down, on the ground inside of the circle. When you give the start signal, students will crawl, slide, “swim” or slink (no walking on two legs) to the middle of the circle to collect as many of the food cards as they can. Remind students that they can only pick up the cards of plants or animals listed for their cave animal. If students pick up a food card not from the approved food list, the card should be placed back on the ground, face down.

Once most of the cards have been picked up, have students return to the large circle. Ask each student to count the number of food cards they have. Each of them is a member of a cave-dwelling food web and needs to have at least three appropriate food cards in order to survive. The students who did not gather enough appropriate food cards have “died” of starvation and will sit out fortheforemost round.

Next, remove five nut food cards and ten detritus food cards from the card list and place them in the center of the circle. This represents the effects of the unexpected sealing of a cave entrance, thus impeding food from washing into the cave. The students who have survived during round one will stand around the circle once the activity has begun.

At a start signal, all remaining students should move as the animals they represent to collect the remaining cards. How many students were able to collect at least three of the appropriate food cards during this round? What observations did the remaining students make?

What’s Going On & Why?: A real life example of this situation could occur if bats were prevented from entering a cave in which they’ve been living. If bats do not return to the cave, the amount of food cards needed for survival.

In the second round of the activity, the number of nuts and detritus cards was reduced, illustrating that if even one strand of the food web was removed, many other organisms would suffer and die.

Note: This activity was adapted from materials developed by Project Underground and was used with permission.
Objective: Students will learn how bats communicate using their senses of smell and hearing.

In The Film: The swarm of bats we see exiting a cave looks ominous with hundreds of flying mammals flapping about madly. One of the film stars, Nancy Aulenbach, takes her second graders on a limestone cave tour in her hometown. The children get to see a fruit bat up close and learn not to fear it. In fact, bats are Nancy’s favorite animals!

Materials:
- Film canisters with lids (one per student)
- Cotton balls
- Several different organic substances with distinct smells (examples of smells: lemon juice, peanut butter, vanilla, cinnamon)
- Blindfolds for each student
- Large room, free from tables and chairs

Teacher Prep Notes: Prepare canisters one day prior to presenting this activity. Soak several cotton balls in the scents by smelling the cotton balls. Once a mother has found her pup, the pair will confirm their findings by smelling and matching their scents.

When and mother and pup have been reunited, ask students to discuss their experiences. Did the mothers find their pups easily? Why or why not?

What’s Going On & Why? The bat’s ear is especially adapted and shaped to gather sound waves. The broad scoop-like form protrudes well above the animal’s head. This allows it to tune into high-pitched sounds and ultrasonic squeaks. The sounds, inaudible to humans, are emitted through the mouth or nose as a bat flies. The radiates out from the animal until they hit a solid object, then bounce back to the bat’s large ears. The sound that is heard by the bat is actually an echo, which helps the animal judge the distance, location, and size of an object in its path.

Bats use their sense of smell when trying to find their young from a large group of pups. Mother bats give birth to live babies called pups. Some species of bats raise their young alone, while some form nursery colonies. Small nursery colonies can contain about 30 or 40 pups, while larger colonies can contain thousands of pups. When the mothers leave the colony, the pups crowd together to stay warm. Upon return, mothers will employ their sense of smell (since most pups look alike!) as well as their acute sense of hearing to listen for their own pup’s high-pitched clicking sounds.

Bat Facts
- Bats are flying mammals. They are warm-blooded, bear live young and nurse their babies (pups).
- Bats are exceptionally vulnerable to extinction, in part because they are the slowest reproducing mammals on earth for their size. Most produce only one pup annually.
- 40% of all bat species are endangered. Worldwide, there are nearly 1,000 species of bats (about 40 species in the U.S.). Another reason bats are exceptionally vulnerable to extinction is loss of valuable shelter areas.
- Bats are found in every part of the world except cold polar Regions.
- Bats live in a wide range of homes, called roosts: caves, mines, trees, and man-made buildings.
- A single brown bat can catch 1,200 mosquito-sized insects in just one hour.
**Activity 4**

A River Runs Through It

**Objective:** Students will learn the difference between a karst watershed, a non-karst watershed, and about the fragility of these watersheds in relation to pollution.

**In The Film:** As we zoom to the Yucatan Peninsula, in Southern Mexico, we see one of the huge temples built to celebrate ancient gods. Under this temple is a huge block of limestone karst, honeycombed with caves. Most of these karst caves are linked to underground water sources for the entire region.

Hazel Barton and her guide dive into one of these caves and swim in water flowing under ancient grounds.

**Materials:**
- Two four-liter plastic soda bottles
- Tape
- Sharp scissors
- Plastic tube long enough to attach the bottles according to diagram and to match the diameter of the bottle neck opening
- Small stones, sand, and aquarium gravel
- Food coloring
- Bowl of water
- Aluminum foil

**Construction of Karst Watershed Model**

1. Cut off the bottom 2 1/2 inches (6 cm) of bottle #2 and set it aside. Pour 2 inches (6 cm) of water into the bottom of the bottle.
2. Place bottle #1 upside down into bottle #2. See diagram.
3. Insert the plastic tube through bottle #1. (Aluminum foil may be inserted around tube to make it fit securely.)
4. Pack stones into the inverted bottle around the tube, making sure the plastic tube extends through the screw cap portion.
5. Arrange the tube until it extends no higher than the screw cap portion of the cut bottle. Tape this into position.

**Construction of Non-Karst Watershed Model**

Follow steps 1 through 3 for Karst Model.

2. Pack stones into the inverted bottle, again higher at the edges and lower in the center. Make sure that you do not place too many stones, as other layers (representing other soil layers) will be added to the model.
3. Place a layer of aquarium gravel (slightly packed) higher at the edges, lower in the center.
4. Place a layer of sand on top of the gravel; again, higher at the edges and lower in the center.

**Teacher Prep Notes:**

This activity is designed to be done as a demonstration for students. It will be helpful to assemble all portions of the models prior to performing the demonstration. If students will be doing the activity, it is recommended that they work in pairs with adult supervision.

**Background:**

A watershed is an area of land where all water, whether ground water or run-off, collects and drains into streams, rivers, lakes, and underground reservoirs. A watershed in a karst area has sinkholes that provide a direct opening, or drain, from the land surface to the groundwater below.

Sinkholes are natural depression in the earth’s surface caused by the collapse of underground cave passages. Sinkholes are common in approximately one quarter of the United States and can be identified as circular depressions in the surface of the earth. Sinkholes are evidence of subterranean water erosion and generally indicate cavities and disolved limestone bedrock near the soil surface. Sometimes sinkholes have open bottoms that provide a direct pathway to underground springs and rivers.

**To Do:**

Assemble the two watershed models as indicated in the diagram. One bottle represents a sinkhole (or karst) watershed and the other, a non-karst watershed.

Identify the ground water, rocky layer, and soil layer for each model, and the sinkhole itself in the karst model. Ask students to explain what would happen to rain and run-off water in each of the models.

Simulate a rainfall by pouring 1/4 cup (95 ml) of water onto both watershed models. Pour water onto one model at a time to allow students ample time to make observations to each. Based on what occurs, ask students to interpret what might happen in these models if pollution were introduced. Ask students to list examples of substances that could make their water unacceptable for drinking.

To illustrate one possible outcome showing pollution problems, place several drops of red food coloring onto the soil layer of each model. Now pour 1/4 cup (95 ml) of water onto each model, one at a time. The food coloring represents pollution on the surface of the ground. When rain falls onto the polluted watersheds, what happens to the pollution? Which model’s ground water became polluted faster? How can pollution be prevented from entering our ground water in real life?

**Taking It Further:**

- Invite a local clear water task force to the classroom to discuss actions that can be taken to keep drinking water clean.
- Find out if your area has karst areas or sinkholes. Learn what you can do to prevent water contamination.

**Key Words**

- **aquifer**—an underground water reservoir.
- **ground water**—water that infiltrates the soil and is stored in slowly flowing reservoirs (aquifers), used loosely to refer to any water beneath the land surface.
- **karst**—a terrain where the topology is formed by dissolving rock, usually limestone, and is generally characterized by sinkholes, underground streams, and caves. Karst makes up approximately 10% of the earth’s surface (and 20% of the U.S.) But about 25% of the world’s population lives in these areas!
- **sinkhole**—depression in the ground caused by the collapse of underlying rock (containing passageways formed in limestone), which provides direct conduits for surface water.
- **watershed**—an area of land where all water collects and drains into a common body of water such as a lake, river, or ocean.

**Note:** This activity was adapted from materials developed by Project Underground and was used with permission.
Objective: Students will learn about early cave art and discuss its importance to ancient cultures.

In The Film: Hazel and Nancy are searching for the smallest of life forms inside of the caves they explore. These tiny organisms, and other cave-dwelling plants or animals are not the only creatures who visit these dark places. Early humans visited caves and left their “writing on the walls”, for future generations of explorers to appreciate.

Materials:
- For Painit:
  - small pieces of red clay (hematite), kaolin clay, gypsum, chalk and charcoal (you may purchase from a biology supply company)
  - Mortar and pestle
  - Brown grocery sacks cut into large rectangles
- For Brushes:
  - Reeds, palm fronds, long grasses, sticks, hair or fur
  - Mortar and pestle
  - Water
- Shells, clay pots, or gourd bowls
- Toothpicks
- Brown grocery sacks cut into large rectangles
- Access to photographs of ancient cave art

Access to photographs of ancient cave art

Teacher Prep Notes: This activity is designed to simulate the technique, painting materials, and paints used by ancient people to create cave art. Tempera paint and ready-made paintbrushes can be used, but for a more culturally accurate activity, have students grind their own paint pigment from the traditional items listed above. Create traditional style brushes to apply the hand-carved paint pigments using the materials listed above. Contact a local Native American museum or Native American organization for more information about native cave art.

Background: Historically, ancient people have been creating paintings on cave walls as an artist’s canvas, chronicling events and details of the time; fortunately some have been preserved for many years. The pictographs created often show other cave visitors—various types of animals the artist was tracking. A simple handprint stamped on the wall, or an image depicting a good hunt are invaluable records by which we learn about ancient cultures.

Early humans left as rudimentary pictures as evidence of how they lived and how they used their imaginations to create art, which matched the physical features of the cave walls. How the art was created and the types of materials used to make the primitive art forms depended on the indigenous materials found in the area. For example, gourds, shells or even large leaves were used as paint mixing pots. Twigs, plant stalks or fingers were used to apply the paint to the walls. Archeological evidence shows that animal fur and bones were also used to apply the paint, creating interesting and often intricate pictographs.

Grinding colored rocks or minerals and mixing them with a liquid created the pigments for pictographs. Ancient people used hematite (red clay) to create a red pigment for painting. Gypsum, chalk, kaolin clay, and even bird droppings were used to create white paint pigment. Charcoal, graphite, and manganese oxides were used to make black pigment and yellow pigment was made by using a limonite (yellow clay) or sulfur chunks. These pigment colors were blended with water, plant or animal oil, urine or even blood to get the proper thickness to be applied to cave walls.

To Do: Ask each student to crumple one large piece of grocery sack, as if they were going to throw it into the trash. Have students smash the crumpled ball of paper several times and then open it up all the way. Next have them crumple the paper again, and open it creating a bumpy weathered-looking piece of paper. This surface simulates the wall of the cave where students will create pictographs.

Ask each student to examine their “cave wall” and see if they can envision images of primitive animal shapes, clouds or other primitive-looking patterns. Students will need to use their imaginations, just as ancient cave dwellers did. If no images are visible (or imagined) ask students to simply paint an image onto the paper.

If you are using the traditional style of creating natural pigments, have students carefully grind small chunks of the desired rock or mineral, using a mortar and pestle. Place the pigment dust into a gourd bowl or large shell, and drip water onto the paint dust and stir with a toothpick. Keep adding water, a small amount at a time, until the paint is the desired thickness for painting. Follow the same procedure for other colors needed. If using tempera paint, pour small amounts of the paint into the small shells or gourd bowls, or into plastic bowls as needed.

To create brushes, ask students to select small amounts from the powdered brush materials. Students should select a brush item based on the desired texture of the brush or paint. For instance, if a long, thin paint line is desired, students can select long blades of grass and hold them together as they paint. If round marks are needed, students may simply choose to use their fingertips. Encourage students to try new objects as brushes and new techniques to make their piece look authentic.

Students can also gather ideas about traditional pictograph styles by looking through pictographs in books from the school and local library. These books will have examples of actual cave art, created centuries ago by ancient people. Ask students to compare their cave art to that of the ancient people. What are the major differences in the style and design?

What’s Going On & Why? Cave paintings, or pictographs, are important images reflecting the use of caves by early humans. They are a beautiful expression from a past generation of people who used the cave and the surrounding areas for basic human survival. These cave drawings are also historical treasures, in need of our protection.

Ancient pictographs are often preserved thanks to the dry, dark conditions inside of the cave. Some pictographs have adorned cave walls for thousands of years. When they were discovered, their possible destruction began. Each time we visit a cave, even to conduct research on the art, we can inadvertently jeopardize these ancient works. Electric lighting, brought into caves by researchers, car, in fact, change the atmosphere and contribute to deterioration of the art. In order to preserve these ancient cave art forms, most states have laws protecting them as valuable resources. It is against the law to remove any formation, fossil, artifact or organism from any cave.

Taking it Further:
- Contact a local Native American club or indigenous group or organization. Invite them to discuss the historic importance of pictograph art to their culture.
- Display cave art on the walls of the classroom and have students write caption cards explaining their design and their painting techniques.

Note: This activity was adapted from materials developed by Project Underground and was used with permission.
ACTIVITY 6

Your Inner Dragons

Objective: Students relate to a caving experience through literature.

In The Film: In every new scene we see Nancy and Hazel adventuring deep into dangerous and exotic cave systems. Each exploration is more breathtaking than the next. Not many people have the opportunity to actually experience what these risk-takers have, thus this film is particularly unique. Dealing with their “inner dragons,” our brave stars dive into a cenote in Mexico and are forced to cope with cramped conditions, poor underwater visibility, and limited air supply. Imagine the stories they will tell when they surface!

Materials:
- Your Inner Dragons copy pages (pages 13-15)

Teacher Prep Notes: This activity can be done as a read aloud activity. Enlist the assistance of a professional storyteller for an exciting twist.

Background: Historically, storytelling was used to relate information to other people. Before the written language, when the spoken word was the only means of communication, stories were an essential part of life. Stories had importance and value to everyone in the community. Family history and the laws of the culture were remembered and passed on in story form.

To Do: Have students listen to the story and ask them to note their feelings about the events. Discuss these feelings after the reading.

What’s Going On & Why? Imagination enables us to see a landscape we’ve never seen, take part in adventures we’ll never otherwise experience, and develop compassion and understanding for different ways of life. Storytelling allows us to use our imagination as we listen. This story gives students an opportunity to be a caver, visit a different cave from the film, and reflect as if they are deep within the earth.

Your Inner Dragons

Uncross your legs and your arms. Stretch out a little. Close your eyes and relax. You will be going on a caving trip. This will be different from a tour in a show cave where you have the comfort of an illuminated and easy walking path. You will have your hard hat on with a light attached to it. Everything you do in the cave will depend on your being able to see by this little light. It will be pitch black in there but you will be fine. Imagine you are ready to depart. A couple of your buddies are putting their helmets on, too, and tugging on the straps under their chins to keep your balance. Your gloved hands help. You see the “twilight zone.” You walk around a corner and the light beam from your helmet shows straight ahead of you. You realize you are not seeing bushes and roots like you did just a few minutes ago, but instead, clumps of dead leaves and twigs that look like they’ve been washed in. A little light still shines in from the entrance. You have been told about this “twilight zone.” “You walk around a corner and the light beam wavers as you move your head. You tighten your chin strap again, and reach up and feel the casing of your helmet. By twisting the casing, the light beam gets bigger, and now you can see more. You crouch under an overhanging ledge. As you clear the ledge and straighten your back, you slowly turn your whole body, in one motion, on the ball of your right foot. The light beam follows right in front of you, staying right with you as you turn. You stop. Without moving your head, you look with just your eyes to the right. You can see nothing outside of the beam of light. It is really dark. You put your hand out to your side and know you must be looking right at your palm but you can’t see it. Moving your head just a little, the light beam now shows your hand.

You are descending, down, down, picking your way carefully over the jutting rocks, crouching to keep your balance. Your gloved hands help. You see the leaves, branches, and rocks on your way down, down, down. Now you notice a lot of trash and you are surprised. Your friends didn’t tell you that a lot of people use this cave, or that some people are very thoughtless. There are bottles, cans, tires, and other ugly things. You also notice a can of bright blue spray paint. You wonder if the rest of the cave will look like this.

Your helmet slips forward and you raise your hand and push it off your forehead, and then tug on the strap under your chin. As you continue on, your footing is easier and the ground is a little more level. It really is beginning to get dark, and the light beam from your helmet shows straight ahead of you. You realize you are not seeing bushes and roots like you did just a few minutes ago, but instead, clumps of dead leaves and twigs that look like they’ve been washed in. A little light still shines in from the entrance. You have been told about this “twilight zone.” “You walk around a corner and the light beam wavers as you move your head. You tighten your chin strap again, and reach up and feel the casing of your helmet. By twisting the casing, the light beam gets bigger, and now you can see more. You crouch under an overhanging ledge. As you clear the ledge and straighten your back, you slowly turn your whole body, in one motion, on the ball of your right foot. The light beam follows right in front of you, staying right with you as you turn. You stop. Without moving your head, you look with just your eyes to the right. You can see nothing outside of the beam of light. It is really dark. You put your hand out to your side and know you must be looking right at your palm but you can’t see it. Moving your head just a little, the light beam now shows your hand.

The light also shows a lumpy wall. It is smooth over the lamps, as if it’s coated. Moving your head up a little, you see that the wall is rougher and
jagged, and when you look up higher, there is more smooth rock, but it seems to be just hanging there with the wall moving your head slightly, your light pans around. It’s such an unusual scene. The ceiling seems so low and jagged. Your light does not reach all the way back to your left, in the darkness over there. You hear voices. Your friends call back and forth to each other to make sure everyone is together. You stand up and walk. The light bounces up and down as you pick your way down the rock, your mud on the rock in every direction. Holding on with your hands as you crawl over them, you put your weight on it. Your heavy boot wedges between two rocks. You tug a little and keep going. A smaller rock turns and you slip and land on your tailbone. Ouch! You remember now why the guide told you to keep at least two hands on contact with the cave at all times when climbing over rocks to avoid slipping or falling. You are all right and you continue on, feeling more sure-footed now.

The passage is tighter now. Your light goes a long way up, but the walls are close. You pick your way along. watching where you step. BAM! You hit your head on a ledge jutting out. You’re very thankful for your helmet.

You wind around and see the skinny passage ahead of you. You turn your head, and shine the light all around. The walls seem so close, and your light is pointing in the direction you are going. You continue to sidestep a few inches at a time. You can feel the closeness of the walls and smell the dampness right in front of your face. You want to turn your head, but it’s time to move again. Your guides are telling everyone to turn their lights back on. You hear everyone talking in hushed tones up and down the line as you continue your journey, deeper into the cave. You start up a little incline and your right foot slips, but you’re able to steady yourself. You wiggle your other foot and turn your head, and shine the light all around.

There’s enough room. The guide following closely behind you suggests that you slide the backpack off your shoulder and turn your head down. You would need to move a little to the side. You slide one of your hands up your chest and push the shoulder strap up over your shoulder and down your other arm. That’s better already. You let the backpack hang from your hand and twist and look at the wall. Cave coral, also called cave popcorn, is the culprit. It feels more like Velcro, you think, because it is so rough and wouldn’t let you slide by. You twist those behind you and the passage widens...wow, this is more tiring than you thought, but luckily the guides have called a break. You sit down to rest and pan your light around. It looks as if the passage is widening and there are large rocks in varying sizes ahead of you. If you keep your legs really a little tine. It feels quite good to sit. 

While taking a break, you notice that the air in the cave has a distinct aroma. It smells musty and you remember smelling anything quite like this before! Something just zipped across your outstretched leg. It was a salamander! As you let your breath out, you are happy you didn’t yell out, as someone did up ahead. One of the group leaders says some salamanders that live deep in caves don’t have any eyes, only eye sockets. Did this one have eyes? It was gone so fast. You wonder what other creatures you might see. Wouldn’t it be great to see a pack of bats? The leader closest to you says pack rats like to live pretty close to the entrance...maybe on the way back out? With everyone seated safely, you guide everyone to turn off your lights. In the quiet, you hear the water again. Drip. Where is it coming from? Is there a pool of water ahead or maybe a waterfall? It’s more of a trickling sound, and seems to be calling you...to maybe take a look. With your eyes closed, you hear, close by, the movements of the rest of the group. You wonder if they feel as you do...

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Extreme Life Forms Chart

<table>
<thead>
<tr>
<th>Animal</th>
<th>Adaptation</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>bat</td>
<td>echolocation</td>
<td>maneuver well in darkness when hunting or avoiding predators</td>
</tr>
<tr>
<td>cave cricket</td>
<td>long antennae long back legs</td>
<td>feel around in dark when hunting or escaping predators, quickly moving</td>
</tr>
<tr>
<td>flatworms</td>
<td>regenerates tail or head extended tube as mouth adhesive organ</td>
<td>continue living, suck up small organisms, moves on walls and other slick</td>
</tr>
<tr>
<td>cave spider</td>
<td>makes webs in cracks</td>
<td>catch flies and bats moving along walls and under rocks</td>
</tr>
<tr>
<td>mites</td>
<td>microscopic in size</td>
<td>live on host</td>
</tr>
<tr>
<td>pseudoscorpion</td>
<td>long claws</td>
<td>grasp prey easily</td>
</tr>
<tr>
<td>blind catfish</td>
<td>vibration sensors scattered over its skin</td>
<td>detect faintest vibrations and guide to food source</td>
</tr>
<tr>
<td>crayfish</td>
<td>long antennae long claws</td>
<td>detect prey in the darkness when hunting or escaping predators, quickly</td>
</tr>
<tr>
<td>remipedia</td>
<td>many fin-like legs</td>
<td>move easily in mud or water (cave swimmer)</td>
</tr>
<tr>
<td>bear</td>
<td>hibernation claws</td>
<td>sleep through the coldest part of winter, dig into dirt of caves</td>
</tr>
<tr>
<td>ringtail cat</td>
<td>long body large eyes</td>
<td>enter small cave entrances, improved vision in low light</td>
</tr>
</tbody>
</table>

References and Other Materials
Most of these books are available from The National Speleological Society Bookstore at the web site of cavies.org.

Exploring Caves: Journeys into the Earth

Caves: Exploring Hidden Realms

Speleobooks
PO Box 101, Chatsworth, NY 13237
www.speleobooks.com

Speleology: The Study of Caves

America’s Neighborhood Bats
By John D. Stiles. An imaginative book appropriate for high school ages through adults.

Bats: Creatures of the Night
By Joyce Milton. Primary reading book with colorful illustrations and factual information.

Bat/Small Square Caves
By Donald M. Silver. Appropriate for upper elementary and middle school aged students.

Stellaluna
By Jane Cotten. A preschool and lower elementary school story and picture book.

Resources
Organizations
American Cave Conservation Association, PO Box 409, Horse Cave, KY 42749
Bat Conservation International, Inc., PO Box 292053, Austin, TX, 78721-2603
http://www.batcon.com

The National Caves Association
4138 Dark Hollow Road
McMinnville, TN 37110
http://www.cave.com

The National Speleological Society
2813 Cave Avenue
Huntsville, AL 35810-4431
www.caves.org

Project Underground
2281 Lubna Drive
Chisipuburn, VA 24073
(540) 81-8234, zokaites@usit.net
mail to: teacher@maclainemill.net

MacGillivray Freeman Films
www.amazingcaves.com

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