



# Caves & Humans—So Happy Together?

*Impact of Human Use*

**Materials:** Computer(s) to access weather statistics ● Background Information  
● Worksheets I & II

Read background information with students and discuss. You may want to have students work in groups to complete Worksheet I: Temperature and Air Movement in Caves and Worksheet II: How Does Human Activity Affect Indiana Caves and Indiana Bats? For Worksheet II, you may want to have a different group work on each cave, then have groups report back to the class.

## Answer Key

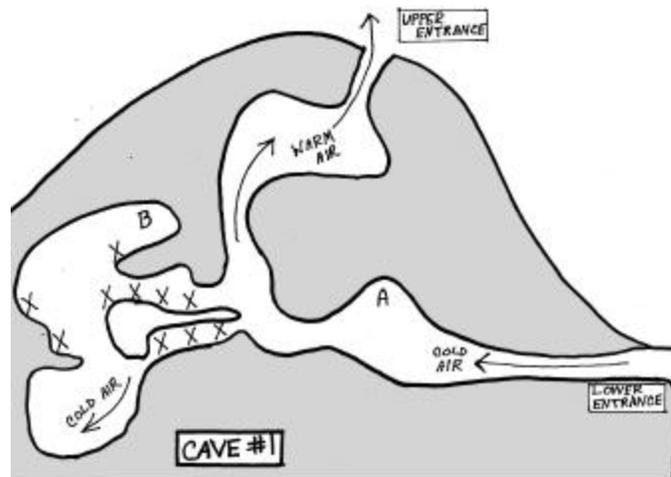
### Worksheet I: Temperature and Air Movement in Caves

Ground temperature in southern Indiana: 56 degrees Fahrenheit, 13 degrees Celsius

NO, this temperature is too warm for Indiana bat hibernation.

### Worksheet II: Does Human Activity Affect Indiana Caves and Indiana Bats?

#### Cave #1: Native American Chert Mining



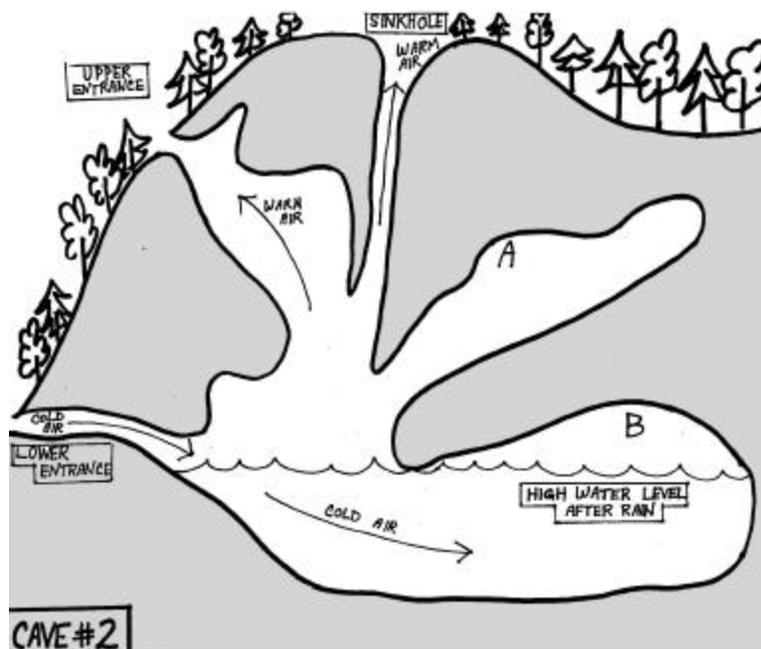


2. Yes, the heat from the pine torches could heat up the area around hibernation location B.

3. Yes, the heat from the pine torches could increase the air flow within the cave. Increased heat rising out of the cave at the sinkhole could create a vacuum, drawing in more cold air from the entrance. Some cave locations might be warmer, while others might be colder.

4. Location A bats should not be affected much, since they will not be disturbed by humans. They might benefit some if colder air is drawn into the cave. The mining would be bad for the bats at location B. The pine torches might create too much heat for the bats to remain in hibernation, and humans in the same “room” with them would disturb their hibernation.

### Cave #2: Changes in Land Use



2. Closing off the sinkhole and blocking the upper entrance causes less air flow in the cave, because the exits for warm air are blocked.

3. Yes, all locations could become warmer (closer to ground temperature) due to decreased air movement. Location B would be the least affected, since cold air coming in the lower entrance would sink into that “room.”



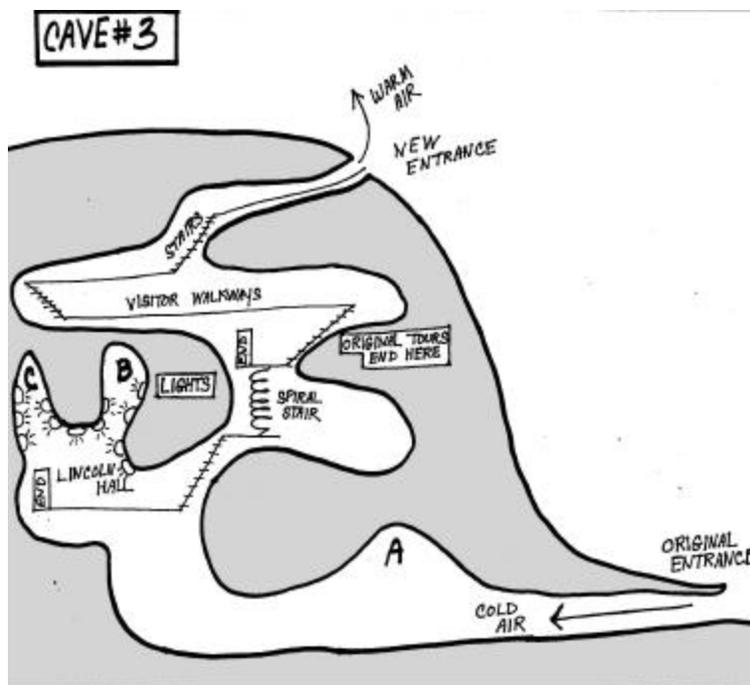


However, from there, the cave passage slopes upward, so the cold air coming in the lower entrance would not move far into the cave. Warm air would be trapped in the upper levels of the cave.

4. Cutting down the trees causes the cave to flood after heavy rain, which could drown the bats or trap them in the spring when they awaken (such as at location B). Cutting down the trees will also cause greater fluctuations in the humidity level of the cave; between rains, the cave may become too dry for the bats, who need at least a 74% humidity level.

5. Yes, we think male Indiana bats spend the summer near the hibernaculum, and they need roosting trees. Also, both male and female bats need trees to roost in during “swarming” in the autumn.

### Cave #3: Developing Caves for Tours





2. Better air flow was created by adding a second entrance. Some parts of the cave became colder, some warmer. More cold air will now be drawn into the lower parts of the cave.

3. The Indiana bats benefited. Increased air flow created more pockets of colder air for them to hibernate (locations B & C).

4. Humans disturbing them and too much heat created by the lights.

5. Answers will vary. The best solution may be to close the entire cave during hibernation months; an alternative more acceptable to the cave developers might be to close the part of the cave where the bats hibernate in the winter, and disconnect the lights in that section during hibernation. Tours could be offered throughout the cave in the summer, but only in the original tour section in the winter, when the bats are hibernating.





Name \_\_\_\_\_

## Background Information: Caves & People—So Happy Together?

### BACKGROUND INFORMATION

#### Hibernation Needs of the Indiana Bat

Hibernation is something many bats do in order to survive when their food sources are scarce. Indiana bats rapidly build up body fat in the late summer and early autumn; these fat reserves have to last until spring. The bats need to wake up from hibernation as little as possible; too much awakening will cause them to burn too much body fat and they will die before spring. Bats can wake up during hibernation because of temperatures that are too warm, or if they are disturbed by humans. They also might wake up to move to a better hibernation spot within the same cave. Before entering the hibernation cave in the autumn, male and female Indiana bats “swarm” around cave entrances to mate at dusk and dawn, and roost in nearby trees during the day.

The Indiana bat requires stable hibernation temperatures **between 4 and 8 degrees Celsius**, and a high relative **humidity above 74%**.

The summer habits of the Indiana bat are not well known. Females may migrate up to 480 km (almost 300 miles) from the hibernaculum to reach their summer nursery roosts. Some males migrate, but most remain in the general area of the hibernaculum during the summer, roosting in nearby trees.

#### Human Uses for Indiana Caves

Caves in Indiana have been used throughout history for the following:

- Mining chert and aragonite to make prehistoric artifacts such as arrowheads
- Mining saltpeter to make gunpowder
- Use of springs for drinking water and to power mills
- Refrigeration of perishable foods
- Cemeteries
- Scientific studies by geologists, archaeologists, and biologists
- Recreational use/development for tourism

**Discussion:** *Which of the above do you think might affect hibernating bats?*







Name \_\_\_\_\_

# Worksheet I: Temperature and Air Movement in Caves

## Worksheet I: Temperature and Air Movement in Caves

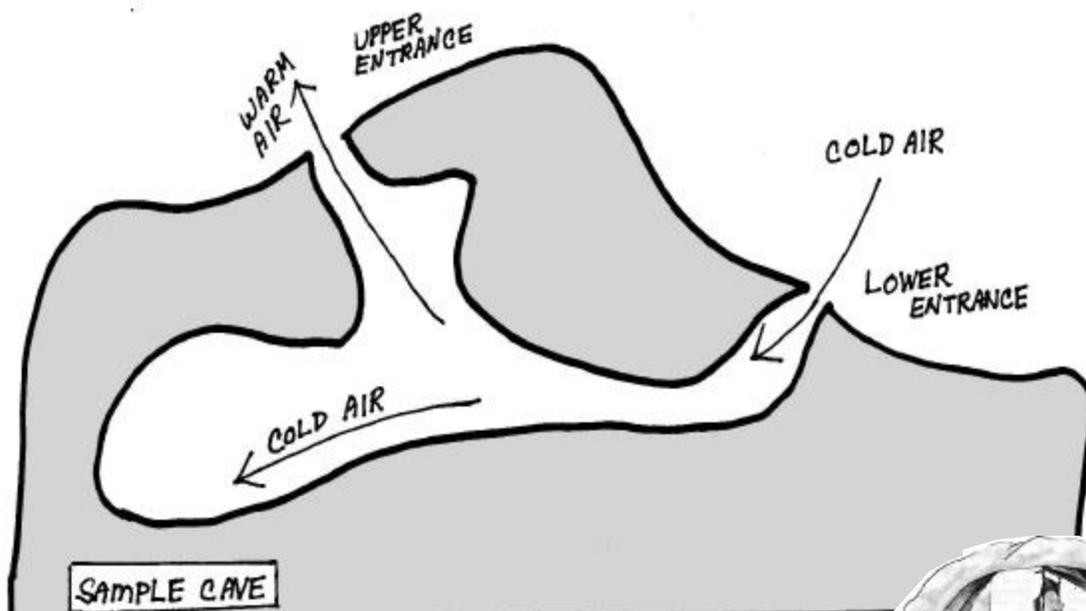
Caves get their temperatures from the ground around them. To calculate the ground temperature several feet below the surface, take the average low temperature and the average high temperature in southern Indiana, and average those. Or, go to <http://www.weatherbase.com/> and select a southern Indiana location such as Evansville to see the average annual temperature.

Ground temperature in southern Indiana: \_\_\_\_\_

Is this the right temperature for Indiana bat hibernation? \_\_\_\_\_

So... how do bats hibernate successfully in southern Indiana?

Many cave systems have “chimney effect” air flow. Because warm air rises and cold air sinks, cave passages that slope downward will trap cool air, while cave passages that slope upward will trap warm air. Caves with two or more openings have better air flow than caves with a single entrance; cool air will sink into the cave and warm air will be pushed out the higher opening. When warm air rises, it may create a vacuum, which will then draw in additional cool air.





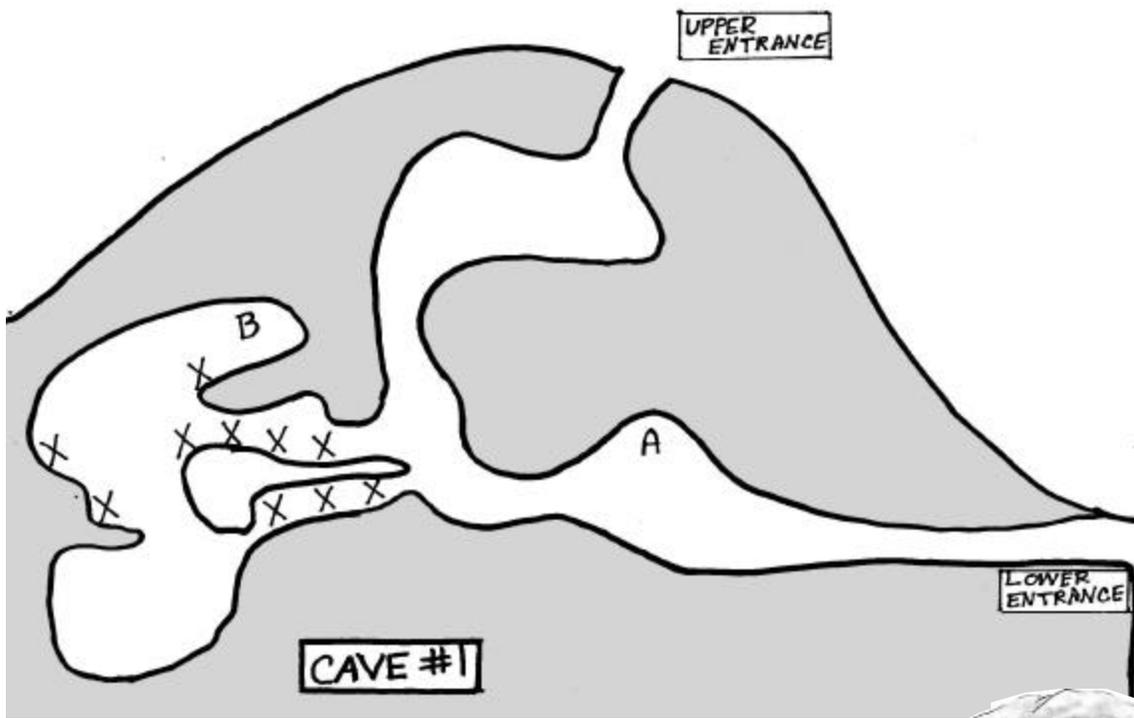


Name \_\_\_\_\_

## Worksheet II: How Does Human Activity Affect Indiana Caves and Indiana Bats?

### Cave #1: Native American Chert Mining

Native Americans carried out mining operations in Wyandotte Cave for thousands of years before Columbus arrived in the New World. Mining was particularly intense from 1500 BC to 600 AD; during this time, the native Americans chipped out a blue-gray material called Wyandotte chert. They traded the chert to other native groups up to 1000 miles away! Wyandotte chert was used to make practical items such as arrowheads, and also used to make religious objects. Archaeologists have found the remains of many pine torches in the cave, which the miners used for light as they worked. In Cave #1, Indiana bats hibernated at sites A and B. Chert mining operations are marked with an X. Suppose that native Americans mined chert for 10 hours a day, every day during the winter months (November-March). Miners entered the cave through the upper entrance, using ropes and ladders to reach the mining area; they did not know about the lower entrance to the cave.





Name \_\_\_\_\_

1. Draw the winter air flow through the cave, using red arrows for warm air and blue arrows for cold air.
2. Could the mining affect the temperature within different parts of the cave?

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3. Could the mining operations affect the air flow within the cave?

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4. How do you think the hibernating bats at location A will be affected by the mining?

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What about the bats at location B?

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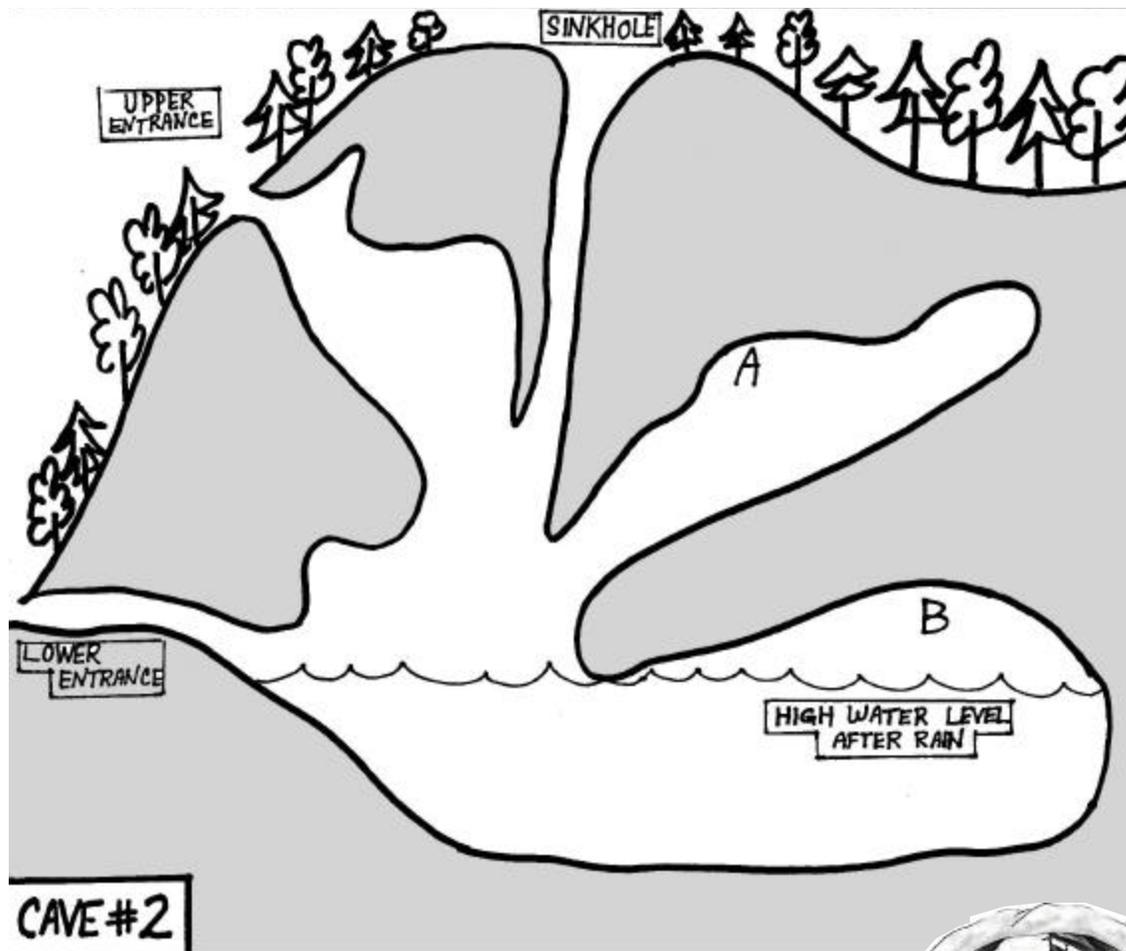


Name \_\_\_\_\_

### Cave #2: Changes in Land Use

Many caves in southern Indiana are threatened by what happens on the surface. Deforestation (cutting down all trees in a large area) can change air flow, temperature and humidity in a cave. Forests capture rain and release it slowly underground. Without the forest, heavy rain can drain away very rapidly, causing the cave to flood. During times of little rain, though, cutting the forests can make a cave drier (less humid). So a forest cover above a cave may help keep the temperature and humidity more stable within the cave.

Cave #2 was originally a dry cave with an upper entrance, a lower entrance, and a large sinkhole. The cave is on private property, and the landowner decided not to open the cave to the public, because she knew that large numbers of Indiana bats hibernated there. In fact, she posted “No Trespassing” signs around the cave, sealed the upper entrance with a gate. She also cut down the entire forest above the cave and used the cut trees to fill the sinkhole. Now, lower portions of the cave flood regularly after heavy rain.





Name \_\_\_\_\_

1. Draw winter air flow through the cave BEFORE the sinkhole was blocked, using red arrows for warm air and blue arrows for cold air.
2. Explain how closing off the sinkhole affects air movement within the cave.

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3. Explain how closing off the sinkhole and blocking the upper entrance could affect temperature at the three hibernation locations.

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4. List two ways that cutting down the trees above this cave might be bad for the **hibernating** bats.

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5. Would cutting down the trees make any difference to the bats during the summer or early autumn, before they go into hibernation? If so, explain.

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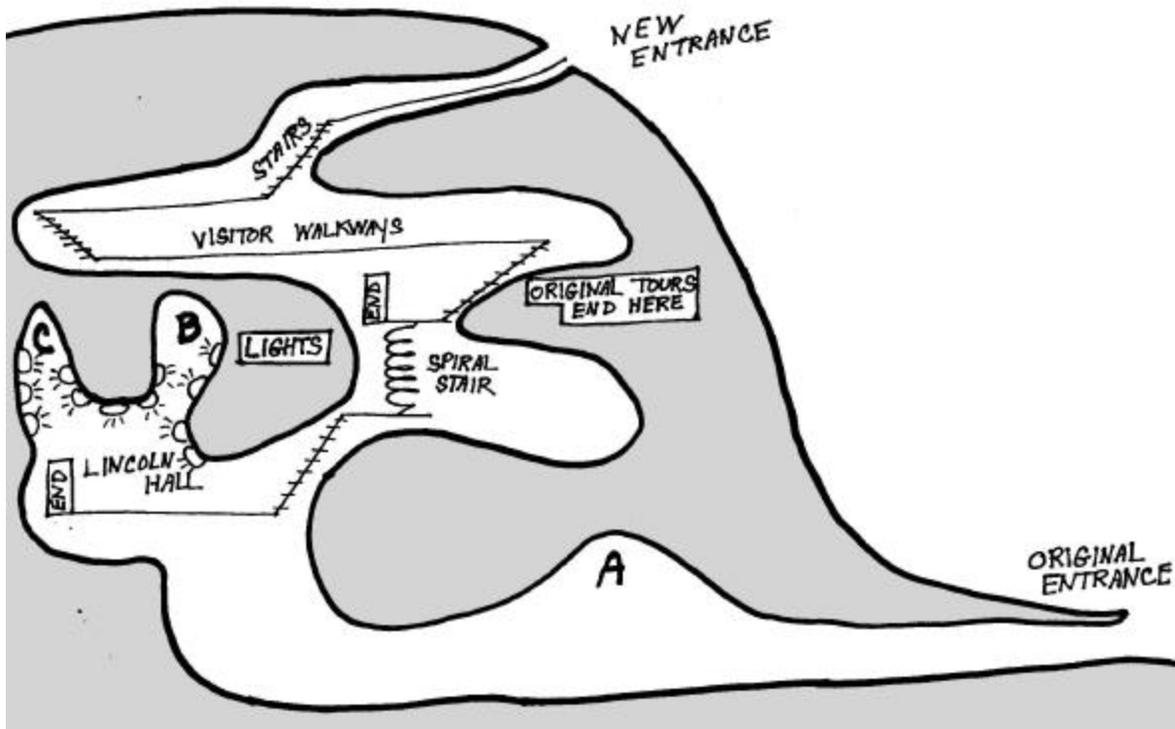
Name \_\_\_\_\_

### Cave #3: Developing Caves for Tours

There are five commercial caves in southern Indiana. Frequently, when caves are developed for tours, new entrances are blasted and bright lights are installed. Some caves have quite a large number of visitors; for example, over 75,000 people tour Marengo Cave every year!

Cave #3 originally had only one entrance, and Indiana bats hibernated only at location A. When the cave was developed for tours, a second entrance was blasted and walkways built so visitors could tour the upper level of the cave. For several years, the number of Indiana bats hibernating in the cave increased. In fact, the bats added two new hibernation locations at B and C. Then, high-powered fluorescent lights were installed in Lincoln Hall so the beautiful dripstone formations in this “room” could be included on the tour. Suddenly, large numbers of Indiana bats started dying during hibernation. Tours go on all year.

#### CAVE #3





Name \_\_\_\_\_

1. Draw (winter) air flow through the cave using red arrows for cold air and blue arrows for warm air, now that it has two entrances.

2. How did winter air flow within the cave change when the second entrance was blasted?

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3. Did the new entrance harm or benefit the Indiana bats?

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4. What are **two** possible reasons that the bats started dying over the winter once the lights were installed in Lincoln Hall and it was added to the tour?

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5. Can we save the Indiana bats and still allow visitors to see this beautiful cave? Write a paragraph explaining your solution to this problem.

