Wild Kids

Hibernation In A Hibernaculum

STUDENT GUIDE

In winter, some vertebrates and invertebrates can enter a state of dormancy or inactivity known as hibernation. Hibernation is an adaptation to cold weather and food shortages. During hibernation an animal's heart rate and respiration decrease drastically and its body temperature falls to equal or slightly higher than the temperature of the surrounding air.

WHY HIBERNATE?

Staying warm requires a great amount of energy. Most small mammals have a high metabolism. So, they need to eat a lot to keep warm. In winter, they give up the struggle to stay warm, and hibernate. By hibernating, they lower their body temperature and do not need to produce as much energy to stay warm. They can live off the fat reserves they accumulated prior to hibernating. Hibernation is a good way to conserve energy.

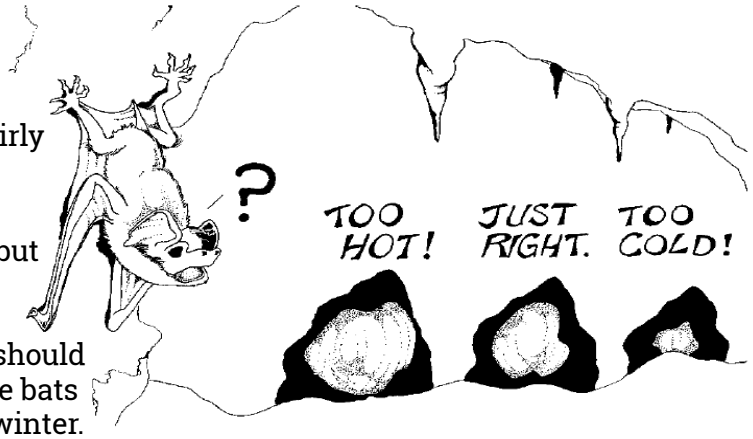
HOW DOES IT WORK?

Hibernation is controlled by a part of the brain called the hypothalamus. The hypothalamus works like a thermostat, a gadget that senses changes in room temperature and switches a furnace or an air conditioner on or off to warm or cool the room. During hibernation an animal's thermostat is set lower, allowing it to maintain a lower body temperature. Scientists have found a substance called HIT in the blood of hibernating animals. HIT stands for Hibernation Inducement Trigger. HIT goes into action when one of three things happens: when there are big changes in temperature (cold or hot), when food is scarce or when days grow shorter and there is less daylight.

Only small and medium-sized animals hibernate. Many species of rodents and bats hibernate in response to food shortages and cold weather. Bears are not considered to be "true" hibernators because their body temperature drops only a few degrees and they can awaken very quickly. Large mammals would have difficulties in waking from hibernation due to the great amount of energy required to raise their body temperature back to normal.

HOW DO THEY CHOOSE A PLACE TO HIBERNATE?

Animals carefully choose their hibernaculum, or hibernation site. It must be cold enough to allow the animal's body temperature to drop low enough that the animal becomes dormant or inactive. In this dormant state the animal's metabolism is slower, allowing it to efficiently conserve energy. The hibernaculum must not be too cold or the animal may freeze to death. Most rodents hibernate in underground burrows where the temperature is fairly constant.



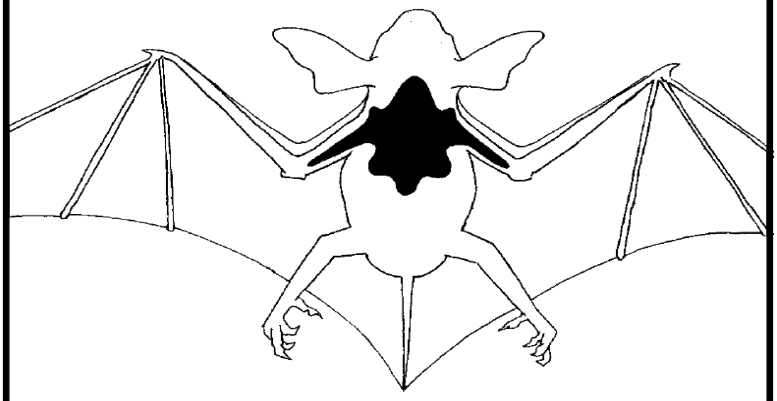
Bats choose a hibernaculum that is not only cold, but humid. This prevents the bats from dehydrating. The hibernaculum must also provide protection from light, noise, and predators. Hibernating bats should never be disturbed. In waking from hibernation the bats may use up their fat reserves and not survive the winter.

WAKE UP!

Animals can arouse or "wake up" from hibernation when necessary. If a hibernating bat's body temperature falls too low, it may shiver to produce body heat or it may wake up completely and move to a warmer place in its hibernaculum. Arousal from hibernation requires a great amount of energy.

To become active again, the bat must raise its body temperature from 40 degrees to 100 degrees in a short period of time! The energy needed to raise the body temperature comes from a tissue called brown fat. Patches of brown fat are most noticeable around the shoulders and back, where it can quickly send heat energy to vital organs – the brain, heart and lungs. It delivers quick energy whenever it is needed.

Brown fat sends a burst of energy to the brain first. The brain can then send messages to the rest of the body to wake up. Next, brown fat sends energy to the heart and lungs to increase heart rate and respiration. The anterior parts of an animal (the head and front legs) wake up from hibernation first and may be 15 degrees warmer than the back legs. Only after the head and front legs warm up do the back legs get a burst of energy and awaken. Within 30 minutes a Big Brown Bat is fully warmed and capable of normal activity!



Location of brown fat on the back and shoulders of a bat.

TRY THIS!

When waking from hibernation, a Big Brown Bat's body temperature increases from 10°C to 38°C in thirty minutes. Make a graph of the following data. (Put the timeline on the bottom of the graph.) Draw one line representing the warming of the heart over thirty minutes and another line representing the warming of the back legs over thirty minutes.

Time (minutes)	Heart Temperature (°C)	Back Legs Temperature (°C)
0	10	10
5	12	10
10	17	11
15	20	13
20	32	18
25	38	28
30	38	34

1. At what time is the difference in temperature between the heart and back legs the greatest?

2. During which time interval does the temperature of the back legs increase the most? Why?

3. Convert the temperature readings to Fahrenheit. What is the bat's heart temperature at 30 minutes, when it is fully warmed?

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TEACHING GUIDE

Overview

In this activity, students read a short article about the hibernation and the specifi adaptations that bats have to allow them to hibernate. Then, they will create a graph from data and answer questions.

Grade
7th

AZ Science Standards
- 7.L1U1.11

Science and Engineering Practices
- Develop and use models

Crosscutting Concepts
- Patterns
- Structure and Function

Suggested Procedures

1. Print the worksheet above. If possible, print it double sided.
2. Have the students read the short article (through the section titled WAKE UP!).
3. Ask students the following questions and discuss:
    - What is hibernation?
    - Why can't large animals hibernate? What about bears?
    - How do bats choose a location to hibernate?
    - What physical adaptations do bats have that allow them to hibernate?
4. Inform the students that they will now create a graph to better understand how a bat emerges from hibernation. Have them read the TRY THIS! section and complete the graph.
5. Once completed, check for accuracy and then ask them to answer the questions. If they need help with the conversion from Celsius to Fahrenheit, you can share the formula: 1.8C + 32 = F.
6. Discuss the results.