MIDDLE SCHOOL
LESSON GUIDE

Into the Outdoors

THE SCIENCE OF TORPOR

Educational Partner

Life Science

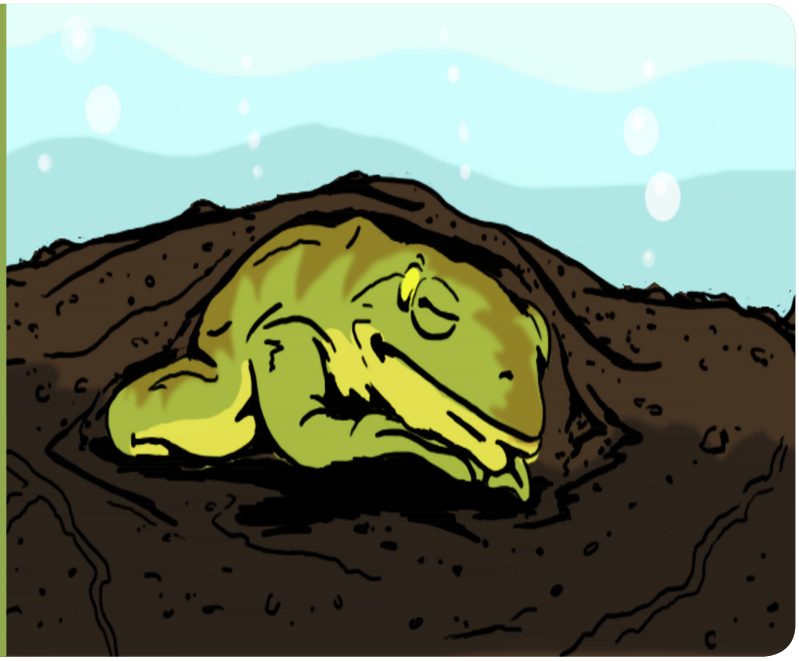
GRADE LEVELS
Middle School - Grades 6-8

CONTENT AREA
Life Science

UNIT THEME
Animal Survival Strategies

TOPICS
Torpor - Animal Survival Strategies

TIME REQUIRED: Video 5 minutes, group work 25-30 minutes. Extensions, several days.



OVERVIEW

Many animals use various strategies to survive extreme environmental conditions such as harsh winter with frigid temperature and dramatically reduced food availability. Birds for instance, have the ability to take flight and migrate great distances to warmer climates where there is more food available.

Other species however that don't have the ability to migrate use more extreme adaptations to survive such as various types of torpor. Torpor is a survival strategy where an animal undergoes a significant reduction in its metabolism and calorie needs. This often involves reduced heart rate, respiration, body temperature, and various body and brain functions. This period of torpor usually coincides to periods when there isn't enough food available for survival, such as during the winter. Black bears and bumblebees use a type of extended seasonal torpor called hibernation where they don't eat or drink for five months.

Bears hibernate during the winter not because it's cold outside, but because there's not enough food available to fulfill their normal calorie needs. Unlike most other hibernators, bears maintain a near-normal body temperature and do not fall into a deep extended sleep. They do sleep off and on in their dens all winter but can easily wake up to defend themselves or their young. They get their calorie needs by surviving off of the large fat reserves in their bodies that they built up by overeating during the fall.

Most insects also use a type of torpor to survive as well. Bumblebees, for instance, hibernate inside a hole in the ground. Similar to bears, they don't eat and survive off the fat reserves stored in their body. However, a bumblebee's body temperature drops significantly to just above freezing. To keep their cells from freezing, their bodies produce natural types of antifreeze. Some butterflies and moths also use this same strategy. Others however, such as the monarch butterfly, take flight and can migrate thousands of miles.

CONCEPT Animal Survival Strategies

ENDURING UNDERSTANDING:

It is important for students to understand that torpor is an important strategy some animals use to survive extreme conditions such as harsh winters and/or unavailable food sources.

CONTENT OBJECTIVES:

Students will develop an understanding of key vocabulary words related to the survival strategy of torpor.

LEARNER OBJECTIVES:

Students will describe how different animals use variations of torpor to survive. They will also compare and contrast the animals discussed in class and how their varying states of torpor are different from other species.

PROCESS OBJECTIVES:

Students will work in small and large groups to process new information and use evidence to come to a conclusion.

MATERIALS NEEDED (each group, each student):

1. Video – Online at http://intotheoutdoors.org/topics/the-science-of-torpor/
2. Paper or notebooks for students to write down questions/take notes during the video
3. Chart paper for groups to use after the video
4. Venn diagram

OVERVIEW *(continued)*

Chipmunks are "food-storing" hibernators that go through long periods of torpor for about a week, where they fall into a very deep sleep. During this deep sleep, their bodies go through a significant reduction in body temperature, breathing, heart rate, and oxygen consumption. They wake up about once a week to urinate, defecate and eat from their stored stash of nuts.

Some small birds, most notably hummingbirds, go through a nighttime period of torpor each day called "noctivation." Because their small stomachs can't hold enough food to keep them alive all night long while trying to maintain their normal high rate of metabolism, they fall into a deep state of torpor each night. During this nighttime period of torpor, they undergo such a severe drop in body temperature and metabolism that they appear to be dead. For example, a hummingbird's heart rate can beat as high as 1,260 bpm, and their normal resting heart rate is around 480 bpm. Yet during their nighttime noctivation, their heart rate can drop to 40 bpm, and their body temperature drops just enough to keep them alive. However, about an hour before dawn, they begin to stir to life, ready again by sunup to begin eating all the nectar and insects they can find. Imagine almost dying every night because of your body's need to fuel your metabolism.

PROCEDURES

1. Before watching the video, ask students what they think torpor means. Discuss as a class. If students need more guidance, ask them to describe hibernation. Lead the class into a discussion about hibernation as one type of torpor and how hibernation can vary between species such as a bear and a chipmunk.

2. Tell students to write down any questions they have while watching the video. Some important questions to be sure to discuss include:

- What is the difference between bears and most other hibernators?
- How and why do bumblebees produce antifreeze?
- What is noctivation?

3. After viewing the video, ask students to share any questions they wrote down and discuss the questions together as a class. If students missed some important questions, be sure to discuss these with the class.

4. Divide students into four (4) groups based on the animals observed in the video (bear, chipmunk, bumblebee, and hummingbird). Have each group of students list how their particular animal has variations in its state of torpor to survive extreme conditions. Have students list advantages and disadvantages of these variations. If students have any additional information to add about the animal that might affect its state of torpor, they should list it at the bottom of the chart.

5. As a class, lead a discussion that compares and contrasts the variations in each animal's state of torpor. The teacher can use a Venn diagram example to contrast and compare the state of torpor between a bumblebee and a bear. Students can then use Venn diagrams to compare and contrast the torpor variations of:

- Chipmunks and hummingbirds
- Bears and chipmunks
- Bumblebees and chipmunks

ASSESSMENT

Students will be informally assessed based on their participation in the class discussion. Teachers could collect the Venn diagrams and the discussion notes students took during the video to check for understanding and completion. Students will also be assessed based on their participation during whole group discussion as well as their participation during the small group activity.

EXTENSION ACTIVITIES

1. To expand students' understanding of heart rate, the instructor could provide students with opportunities for them to record and analyze their own heart rate. Students can compare and contrast their heart rate findings to that of a hummingbird and a chipmunk (presented in the video). Some sample lessons are included in the additional resources section below.

2. To broaden students' understanding of metabolism, have them list four (4) factors that could be used to gauge the rate of metabolism. Then have them list two things that might affect each of the four factors. Example: The factor of heart rate can be affected by physical activity and brain function.

SPECIAL CONSIDERATIONS:

1. During the video, the instructor may want to stop the video bewteen topics or species to allow students time to take notes.

2. The instructor may want to have some questions prepared to ask students who had a hard time thinking of their own questions during the video.

3. Depending on the class, the instructor may want to divide the class up into groups to ensure they are equal sizes if students are having a hard time choosing their group.

RESOURCES

- http://www.wisconline.com/attractions/naturecenters.html (a complete list of nature centers in WI)
- http://www.exemplars.com/education-materials/free-samples/science-6-8 (sample heart rate lesson plan)
- https://www.heart.org/idc/groups/heart-public/@wcm/@fc/documents/downloadable/ucm_451993.pdf (sample heart rate lesson plan)

The following **Student Proficiency Standards** can be met by teaching the SCIENCE OF TORPOR:

WISCONSIN STATE STANDARDS AND BENCHMARKS

C.8.1 Identify questions they can investigate using resources and equipment they have available

F.8.7 Understand that an organism's behavior evolves through adaptation to its environment

F.8.9 Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or population growth of certain species

The following **National Common Core Standards** can be met teaching the SCIENCE OF TORPOR:

NATIONAL COMMON CORE STANDARDS

CCSS.ELA-LITERACY.SL.8.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

CCSS.ELA-LITERACY.SL.8.1.C
Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.

CCSS.ELA-LITERACY.SL.8.1.D
Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented