Numbers in Nature | 2nd Grade

How Do Animals Survive The Winter?

Objective: To understand the different strategies that animals may use to survive the winter; to gain understanding of the state of hibernation; to model how animals prepare for hibernation in a game; to practice word problems involving addition/subtraction, counting months of the year, and drawing temperature on a thermometer.

Common Core State Standards: Grade 2
2.OA.1 Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
2.NBT.8 Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.
2.NBT.2 Count within 1000; skip-count by 5s, 10s, and 100s.

Lesson Format:
Location: In classroom (20 min), outdoor (30-40 min)
Time: 60-75 minutes

Materials:

- HAM photos (3)
- Hibernation photos (Black bear, Arctic ground squirrel)
- Plastic cups (30+)
- Beans (in container) some students have nut allergies, don't use real nuts
- Red bandanas (6)
- Math worksheets (post-lesson option)

Background:
Winter can be a difficult season for many animals to survive. Think of the animals that live in the High Cascades during the summer and fall. What do they do when winter comes?

Winter is challenging for two main reasons: 1) **cold temperatures and heavy snow** and 2) **little to no food** (especially for herbivores). Because of these challenges, animals have developed different strategies and adaptations over time to best cope with the winter.

HAM

1) **Hibernation**, a state of dormancy/inactivity in which an animal slows its bodily functions and metabolism while in a food shortage

2) **Adaptations**, special traits developed over time to help an animal survive by being better adapted in its environment. “Adapters” are able to “tough it out” and endure in snowy alpine environments. These animals will continue to be active in the High Cascades during winter. Many predators are adapters (bobcat, lynx, marten, otter, weasel, coyote, wolf), as well as beaver, snowshoe hares, and other small mammals.

Winter Adaptations:

- Changing coat color to white for camouflage (Snowshoe hare, Short-tailed weasel)
- Large feet to walk on deep snow (Snowshoe hare, Lynx)
- Thick, waterproof fur/feathers to stay warm and dry
- Living in communal dens to trap body heat to stay warm (rodents)
- Living in the **subnivean zone**, the zone underneath the snowpack near the earth, to provide shelter (predators may also hunt in the subnivean zone)
- Food storage strategies, storing large amounts of food prior to winter (Clark’s Nutcracker)

2) **Migration**, the seasonal movement from one region to another to meet their needs for survival (food, nesting sites, seasonal conditions). Some animals migrate to lower elevations from the High Cascades before winter strikes. These animals would otherwise survive the least well in this alpine environment, by not finding any food or not being well adapted for deep snow or cold temperatures. Animals may migrate short, medium, or long distances. Birds and butterflies may migrate hundreds or thousands of miles south to warmer regions (Southwest, Mexico, Central America, South America). Elk and deer migrate shorter distances from high elevations in the mountains down to lower elevations in valleys/towns.

Is hibernation like sleeping? Not quite. An animal must be specially adapted to be able to hibernate, it is not a spontaneous choice. Hibernation is a state of inactivity or dormancy in which an animal can conserve energy during the winter by greatly reducing their metabolic rate, internal temperature, heart rate, respiration, waste elimination, and

other bodily functions. Hibernation is a way to save energy during winter when food is scarce, like “unplugging” an animal to save energy or “shutting down” for the winter.

Is all hibernation the same? No. There are various levels of hibernation: true hibernation, torpor, shallow hibernation/denning, and estivation. **True hibernation** is the most extreme state, with metabolism being reduced to near death. Body temperature drops close to ambient temperature, the animal may lose up to 30-50% of its body weight, breathing is almost undetectable, and internal organs are nearly inactive. The animal appears dead and is not easily woken by disturbance; however, they may wake up periodically to eat stored food. True hibernation is costly and dangerous: advantageous for the survival of the species, but not for the individual.

Estivation is a state of dormancy to survive a hot/dry season. **Torpor** is a much more shallow state of dormancy, which may only last hours or days, and with less extreme metabolic changes.

Are hibernating animals safe from predators? More safe than if active, but not always. Hibernating animals are difficult to detect by predators: they don’t move, smell, or make noise. Although if found, they are very vulnerable due to depressed state.

How do they prepare for hibernation? 1) By eating as much as possible during summer and fall to store extra fat. Their body will survive off of this fat storage during hibernation. If there’s not enough fat storage, the animal may die. 2) Finding appropriate shelter. Animals may build a burrow underground or find a tree hollow, den or cave. The animal may be in this space for up to 8 months, so it is an important decision to be in a safe spot. 3) Storing food in a **cache**, or secret food storage, to consume intermittently throughout hibernation (not all hibernators will do this).

What kinds of animals hibernate? Squirrels, chipmunks, marmots, mice, skunks, voles, bats, snakes, frogs, bees, hedgehogs, one bird (Common Poorwill) and one fish (Atlantic Cod).

Arctic Ground Squirrel: A large ground squirrel found in the Arctic regions of Alaska and Canada, living in colonies of underground burrows. They feed on seeds, berries, and leaves. They are **true hibernators,** spending over half of their life in hibernation. At 8 months of hibernation, they are the longest and deepest hibernators on the planet.

They have the lowest hibernating body temperature ever recorded, often reaching below freezing. To prepare, the squirrel builds a burrow underground (lined with grass,

hair, lichen, etc. for insulation) and stores a cache of food inside. The “hibernating position” is curled up into a ball with the extremities tucked in. Awakening from hibernation takes ~3 hours and is stimulated by warmer temperatures. Arctic ground squirrels will mate and give birth in the spring after waking up.

Heart rate change: ~300 beats/minute to ~3 beats/minute
Hibernation duration: 7-8 months, September/October - April/May
Average body temperature change: 99℉ to 27℉
Body weight change: 30-40% loss
Respiration change: 3 slow breaths/minute
Arousal period: Every 3 weeks

Black Bear: Black bears exhibit denning (a state of torpor), and are **not considered “true hibernators.”** Bears are easily woken during hibernation, wake up to give birth in January/February, and do not exhibit extreme metabolic reduction of the body as true hibernators do. However, bears will “hibernate” for 4-7 months without eating, drinking, urinating, or defecating, and they heavily rely on stored fat for the duration of winter.

Heart rate change: ~60 beats/minute to 10-14 beats/minute
Hibernation duration: variable, 4-7 months, September/October - April
Average body temperature change: 100℉ to 93℉
Body weight change: 40% loss

A. In Class Discussion: 20 min

Start by posing the question: how do animals survive in the winter? Why is winter hard for animals to survive? Focus the class to think about the animals living in our own High Cascades. Call on students to come up with 1) little to no food and 2) cold and snowy.

So what kinds of strategies can animals use to survive? Introduce the acronym **HAM** as their clues, the 3 main strategies for winter survival. Call on students to come up with the 3 HAM strategies (give hints as needed), then reveal with a photo and briefly discuss each. What are some strategies that humans do to help us in the winter?

Comparing the Arctic Ground Squirrel vs. Black Bear: Explain hibernation further by showing photos and comparing the hibernation of an Arctic Ground Squirrel and a Black Bear. Share some of the numbers associated with slowing down their body systems.

Is all hibernation the same? How do they prepare? Show and explain a photo of a bear before and after hibernation to show weight gain and loss. Show photos of burrows and

dens and explain the importance of finding a safe shelter to hibernate in. What other kinds of animals hibernate?

Testing Changing Heart Rate: Optional/Time Permitted

To help save energy during hibernation, animals slow down their body, including their heart rate. Have the class test this out by changing their own heart rate from a state of rest to high activity. How does exercise change your heart rate?

First have students determine their heart rate by counting the number of beats in 15, 30, or 60 seconds. Then have the students do jumping jacks for 1 minute. Determine their heart rate after exercise.

- How did it change?
- Which action took less energy? More energy?
- If you were an animal trying to save energy during the winter, would it be better to sit still or do jumping jacks?

B. Prepare for Hibernation! Squirrel-Cache Game (30-40 min)
Head outside for a game all about strategy, that models squirrels preparing for winter hibernation. To survive winter hibernation, they need to 1) hide their burrow in a secret, safe spot, 2) collect a cache of nuts in their burrow and 3) avoid predators. Predators also need to eat to survive the winter! The more natural features in the outdoor space, the better.

A. Most students will be squirrels, with 2-5 predators in each round. Play 3-4 rounds total. **Start with 1-2 predators and increase by one for each round**.
B. Predators will wear a red bandana around their wrists. Squirrels will be given a clear, plastic cup as their burrow. The cup (burrow) will hold their cache of beans (nuts). Note to students that their name is not on their cups, it is their responsibility to remember where it is and not mix it up with a buddy.
C. Establish boundaries where the squirrels may hide their burrows and designate a “home base” where you will restart after every round. An area with natural space is best, but play structures work well too.
D. Once they hide it, they may not move it for that round. They may bury the burrow around the sides with sand or gravel, but only the beans should be inside the cup.

E. While predators are closing their eyes, release the squirrels to hide their burrows. Give squirrels 1-3 minutes before releasing the predators. As soon as a squirrel has hidden their burrow, they may start collecting beans. You, the instructor, will be holding the container of beans. **Squirrels may only collect 1 bean at a time.**
F. When predators are released, they will be looking for the hidden burrows, not tagging squirrels. When they find a burrow, they will bring it to you (beans included). **Predators may bring you one burrow at a time**. Stack the cups to count how many squirrels they "eat".
G. Advise squirrels to be very sneaky and careful when they return to their burrow with nuts. They don't want to lead a predator to their burrow.
H. After a few minutes or when many squirrels are eaten, stop the game and regroup everyone at home base. Discuss what happened.
    A. **How many squirrels got eaten? How many squirrels survived?**
    B. **Of those who survived, who collected the most nuts?** Call on a few students to share their number of nuts collected. The student who survived and collected the most nuts has the option to be a predator in the next round.

For the next rounds, select new predators (increase by 1) and challenge students to hide burrows in a different spot.

Wrap up:

- Was it difficult to be a squirrel preparing for hibernation?
- What was challenging about this game?
- This game is all about strategy. What were some strategies you used as a squirrel? As a predator?

C. Hibernation Word Problems: Optional Post-Lesson Worksheet

In these worksheets, students will work with real numbers relevant to hibernation, while learning how the animal's body changes during hibernation. Encourage comparisons:

- Which animal's body temperature dropped more?
- Which animal's temperature reached below freezing?
- Which animal has their babies during winter?