Ecology in Classrooms & Outdoors

COLD WEATHER ANIMALS PT. II
TEACHER GUIDE

Introduction

In this two-part lesson, students will learn how different animals survive in cold environments using their physical, behavioral, and physiological adaptations. First, students are introduced to ectothermic animals, or animals that rely on external sources of heat. They will discover that ectotherms are typically more reliant on their behavioral adaptations to keep warm during the colder months of the year. Then, students are introduced to endothermic animals, or animals that maintain their internal temperature through biological processes. For these animals, students will focus on how physical adaptations help them to survive in cold climates. After each lesson, students have activity options to act out, draw a diagram, build a model, write an explanation, or a combination of these to create their own perfectly-adapted cold weather animal.

Materials

- Cold Weather Animals Pt II presentation
- Student activity sheet (3 pages)
- Pencil, paper
- Coloring supplies (optional)
- Other craft materials: fabric, paint, construction paper, collage, yarn, etc. (optional)
- Household items like blankets, jackets, etc. (optional)

Lesson Length

30-40 min asynchronously or synchronously

Standards

NGSS

2-LS4-1 Biological Evolution: Unity and Diversity
Make observations of plants and animals to compare the diversity of life in different habitats.

3-LS3-2 Heredity: Inheritance and Variation of Traits
Use evidence to support the explanation that traits can be influenced by the environment.

4-LS1-1 From Molecules to Organisms: Structures and Processes
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MS-LS1-4 From Molecules to Organisms: Structures and Processes
Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Lesson Procedure

1. WEATHER VS. CLIMATE

To begin, it is important that students understand the difference between weather and climate. **Weather** is defined as the atmospheric state at a specific time or season, such as the temperature (hot/cold) or precipitation level (rain, sleet, snow, hail, dry). **Climate** is defined as the weather conditions that prevail in an area in general over long periods of time.

Animals living in cold-climate ecosystems have adaptations that help them live in these harsh conditions year-round, while animals that live in regions with more varied temperatures throughout the year have adapted to endure the colder winter months in different ways. As students learn about examples of each, keep in mind how this idea applies to different animal adaptations.

2. WHAT ARE ADAPTATIONS?

All living organisms have **adaptations,** or defining traits that species have passed down through generations that help them survive in a particular environment. For animals, this means adaptations are what help them to find food, hide from predators, attract mates for reproduction, and survive various weather conditions.

Adaptations can be:

- **Physical:** special body parts that help a plant or animal survive in an environment (e.g. the thickness of the fur, structure of the beak)
- **Behavioral:** actions animals take to survive in their environments (e.g. the way an animal builds a den, migrates from one part of the world to another)
- **Physiological:** internal body processes to regulate and maintain homeostasis for an organism to survive in the environment in which it exists (e.g. the release of toxins or poisons to ward off predators)

Animals that live in cold environments rely on key adaptations that help them survive the cold, whether it's wintertime or they live in a cold-climate ecosystem like the mountainous alpine or the arctic tundra.

3. DEFINE ENDOTHERMS

Animals that rely on internal (**metabolic**) processes to maintain a stable body temperature, regardless of the ambient temperature, are known as **endotherms**. Endotherms are also often called "warm-blooded" animals.

Because endothermic animals rely on their metabolic processes to regulate their internal temperature, being an endotherm takes a lot of energy. This means that endothermic animals rely on food to fuel their metabolism and maintain a stable body temperature. When the weather gets cold in the winter, or for endotherms that live in cold climates year-round, animals must turn to their adaptations to help them **generate heat** and **conserve heat** to survive.

Because of this, endotherms often rely on **physical adaptations** to help them maintain their body temperature during the winter months. And, some **behavioral adaptations** are seen in many endothermic species. Endotherms are found in all parts of the globe, from the hottest deserts to the coldest polar regions. Begin by asking students if they can think of any examples of endotherms, or "warm blooded" animals. Types of endotherms include mammals (including humans), marsupials, and birds. There are even some fish species that are endothermic!

Then, go through the presentation titled **Cold Weather Animals, Pt II**, to learn more about some fascinating endothermic animals and the adaptations they use to survive in the cold.

Lesson Procedure, cont.

4. DISCUSS ADAPTATIONS & EXAMPLES

As you go through the presentation slides, take note of the physical and/or behavioral adaptations listed.

Some common physical adaptations include:

- **Insulation**, which conserves heat by creating a layer or air or barrier between the animal and the cold air (or water) around them.
  - Blubber or fat: many endotherms have layers of fat (or sometimes called blubber) to insulate their bodies from the cold. Marine mammals such as whales, dolphins, seals, walrus, and sea lions have a thick layer of blubber.
  - Thick fur, hair, wool: the colder the climate, the thicker the fur! Sheep's wool for example, is one of the best materials for thermal insulation due to its curly fibres that trap air pockets throughout the wool. Polar bears are covered in hollow hair strands that trap air to keep them warm. Other examples of animals with famously thick, warm fur include the American pika, beaver, and alpaca.
  - Feathers and air pockets: feathers are structurally one of the best insulation materials on the planet. It's no wonder that humans use down feathers as insulation in everything from jackets to sleeping bags! Birds also stay warm by creating air pockets in between their feathers, which also work to insulate them from the cold. When birds preen their feathers, they are keeping them clean and neat so they can trap air more efficiently.
- **Waterproofing** is critical for animals that live in wet climates or aquatic habitats. In these instances, staying dry is the key to staying warm. For example, birds have a special oil coating on their feathers that repel water. Beavers, who spend most of their time in the water, also have a special oil that comes out of a gland near their tail. Beavers use a specially-adapted split nail on their paws to comb the oil through their fur to keep it waterproofed.

Some behavioral adaptations include:

- **Dormancy**, a method of slowing down bodily functions such as heart rate and metabolism.
  - To conserve energy, many endothermic animal species will go into a state of dormancy known as **torpor**, in which their body temperature drops and their metabolism decreases for an amount of time. Although they are in a sleep-like state, animals in torpor can easily resume activity to collect more food or move locations. Birds, bears, and chipmunks are known to go through states of torpor to survive the cold.
  - Some mammals, such as woodchucks, bats, and skunks, go into true **hibernation** during the cold winter months. Hibernation is a prolonged state of torpor, where the animal's metabolic processes slow down and their body temperatures drop to conserve energy throughout the winter when food is scarce. Animals that hibernate will find a safe, sheltered location like a hole or cave where they can be shielded from the elements and/or predators. Unlike torpor, animals in hibernation are very difficult to arouse and thus take a longer time to come out of.
- **Food caching:** since food equals energy, and energy equals warmth, it is important for cold-climate animals to ensure they have enough food to last them through the winter. American pikas, which live year-round in high alpine environments, will stack their food in piles among the rocks to save for later. Birds, like the black-capped chickadee, and small mammals, like squirrels, will cache nuts, berries, and seeds in holes in trees for winter feeding.
- **Migration:** some endotherms travel to warmer regions during the winter. For example, the hoary bat migrates to more temperate regions in the US and Mexico, where they are able to find plenty of insects to eat. Canada geese are also well-known migratory birds, flying south for the winter after the breeding season.

Lesson Procedure, cont.

- **Kleptothermy:** also known as cuddling, endotherms like the beaver will take advantage of the body heat of their family group to stay warm.

American pikas are native to the western part of North America at altitudes of 8,000-13,000 ft. They live in the mountainous rocky alpine habitat and eat plants. To survive the cold temperatures, pikas have thick fur for insulation, small, rounded bodies to help them hide from wind chill, and furry paws to help them scramble on snow. They also cache or store food year-round in piles called "haystacks". Pikas are at high risk of disappearing due to changes in climate. To learn more about the pika, read this post from Oregon Wild.

Many **bats**, like the little brown bat, hibernate through the winter in caves or other dark, dry, safe places, while other bats, like hoary bats, migrate to warmer climates to find food.

Alpaca are well-adapted to high alpine regions of the Peruvian Andes due to their long history of being bred for their fibre. Alpaca hair fibres are hollow, which traps air to insulate them from the cold. Alpaca hair is also very thin and densely packed, making it perfect for humans to shear, spin, and weave into blankets, sweaters, hats, and other warm clothing.

Polar bears have many physical adaptations that keep them warm in their icy habitat year-round. Polar bear fur is hollow and densely packed, which traps air to insulate them from the cold. They have a thick layer of fat for extra insulation, and their oily coat sheds water to keep them dry. Because they are so well-adapted to the cold, polar bears don't need to go into a state of dormancy, with the exception of pregnant females.

It's no wonder humans use goose down feathers to insulate our warmest blankets and winter coats. **Canada geese** stay warm with their two types of feathers: fluffy down feathers for insulation, and waterproof outer feathers. Canada geese also have a few behavioral adaptations to stay warm, including tucking their beaks into their feathers for warmth, alternating standing on one leg, then the other (or sitting), and some migrate to warmer regions after the breeding season.

Well-suited for their wet and cold habitat, **beavers** stay warm by storing extra body fat (especially in their tails), and using their extremely thick fur with an oily, waterproof coating to stay dry. Beavers are also expert builders, and use their lodge structure to maintain heat when their pond may be frozen over. They build well-insulated, two-level lodges to stay out of the cold, cache extra food to consume throughout the winter, and huddle together with family members for extra warmth.

Bonus: **macaques** of Japan have their thick, shaggy coats for warm insulation, but they have also developed an unusual behavior over time to benefit from the warmth of natural thermal pools! Watch the video to learn more about how these monkeys have learned to get extra heat in the far northern reaches of Japan.

5. HOW TO HELP ENDOTHERMS IN YOUR OWN COMMUNITY

Endotherms come in many shapes and sizes and are found in a variety of habitats, even in our own backyards! To help play a role in protecting local mammals (including humans) and birds, there are a few things students can do to keep endotherms safe during the winter.

Lesson Procedure, cont.

Here are some ways students can protect native ectotherms this winter:

1. **Feed the birds**: when food is scarce for birds in the winter, supplementing their diet with a bird feeder can help them and provides a great way to watch birds up close!
2. **Do not disturb**: small mammals may be hibernating in holes or underground nooks. Don't poke into dens or allow dogs off leash.
3. **Share the warmth**: humans are endotherms, too! Winter can be challenging for folks with fewer resources. Find a local charity and donate your extra blankets, jackets, and other warm layers to spread the warmth in your community.

6. ACTIVITY: CREATE A COLD WEATHER ENDOTHERM

For this activity, students will get creative and build their own endotherm using the activity sheet to record their ideas or their choice of materials (drawing, painting, 3D craft supplies, costume pieces).

Students will determine a habitat, real or imaginary, where their animal species lives. Looking at the examples provided in the presentation and on the activity sheet, or after doing additional research on their own, students will create their endothermic animal and label the adaptations it uses to survive cold temperatures.

Use these guiding questions to get students started:

- What habitat does the animal live in (arctic, boreal forest, wetland pond, alpine, tundra, cold desert?)
- What happens to this species when it gets cold outside, either during the winter or nighttime?
- How does the animal use physical adaptations and/or behaviors to maintain their body temperature?
- What other adaptations does this animal have to survive through the winter or in a cold climate?

7. ACTIVITY: EMBODY YOUR ENDOTHERMY

Assign the **Embody Your Endothermy** activity sheet to have students practice their own ways of keeping warm. After all, as mammals, we are all endotherms! Use the sheet as a BINGO-style board with fill-in-the-blank squares for students' own ideas.

8. SHARE

Invite students to share their endothermic animal creation and/or their Embody Your Endothermy activity sheet with the group, in person or over your preferred digital learning platform.