

## Surviving the Cold

On another EarthDate, we told you how animals beat the heat. They've also developed remarkable traits, and behaviors, to survive the cold.

Mammals and birds are warm-blooded – they make their own heat. But must keep the cold from stripping it away.

First by avoiding it. Wandering grazers, like elk and caribou, come down into warmer valleys in winter. Migrating birds just fly away.

Those same grazers, and predators like wolves and foxes, grow coats much warmer than summer fur. Likewise, birds' outer feathers block the cold, while soft down beneath traps warm air.

Some find safety in numbers. Musk oxen huddle tightly together. Penguins rotate positions in their huddle, taking turns on the icy outside. Others sleep through the cold, slowing their heart rate and hibernating in warm burrows.

Marine mammals build layers of fat -- with a purpose! Blubber insulates, keeps them afloat, and is a winter energy store.

Fish, reptiles and amphibians don't have an internal heat source. As their body temperatures drop, many go dormant. Fish hide in crevices, barely breathing. Reptiles and amphibians hibernate underground.

Some species have special blood chemistry to keep from freezing; or to protect their cells as their bodies freeze solid, before thawing back to life in spring.

Migration and hibernation, feathers and fur, fat and antifreeze – myriad ways to survive and thrive in the cold.

I'm Scott Tinker.



Animals of all shapes and sizes have developed unique and varied ways to survive cold.

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# Background: Surviving the Cold

**Synopsis:** When winter grips the planet, life faces one of its greatest tests. Across frozen tundra, icy lakes, and snow-covered forests, temperatures plunge far below what most creatures can survive. Yet life endures, and even thrives, by adapting in ingenious ways.

## A Variety of Adaptations

- The cold is more than a season. It is a power force that shapes evolution. To outlast it, animals have developed remarkable defenses: fur and feathers, fat and antifreeze, migration and hibernation.
- From mammals and birds to fish and frogs, each has learned a different way to beat the chill.

## Mammals: Masters of Warmth

- When icy winds sweep across the landscape, mammals use the tools of heat and teamwork.
  - Preparation begins early. As summer wanes, elk and caribou move to lower valleys, while wolves and foxes grow thick undercoats that trap air like blankets. Caribou (reindeer) possess even more remarkable winter adaptations, from specialized hooves to hollow insulating hairs, as explored in our EarthDate story [The Miracles of Reindeer](#).
  - Some choose to sleep through it. Bears, bats, and groundhogs hibernate in burrows and caves, their heartbeats slowing to just a few per minute. The small, enclosed space traps enough heat to keep them safe until spring. We took a closer look at this remarkable survival strategy in our earlier EarthDate story, [Not a Creature Was Stirring](#).
  - Others face the cold together. Musk oxen form tight circles against the wind, and penguins rotate positions, so each individual takes a turn on the icy edge.
  - And for marine mammals, warmth runs deep. Seals, whales, and walruses store energy as blubber, thick insulating fat that lets them float through freezing seas as if wrapped in a winter coat.
- Mammals survive the cold by staying warm from within, through heat, heart, and herd.

## Birds: The Weightless Survivors

- Where mammals rely on mass, birds depend on design. They may look delicate, but their feathers, instincts, and endurance rival any mammal's

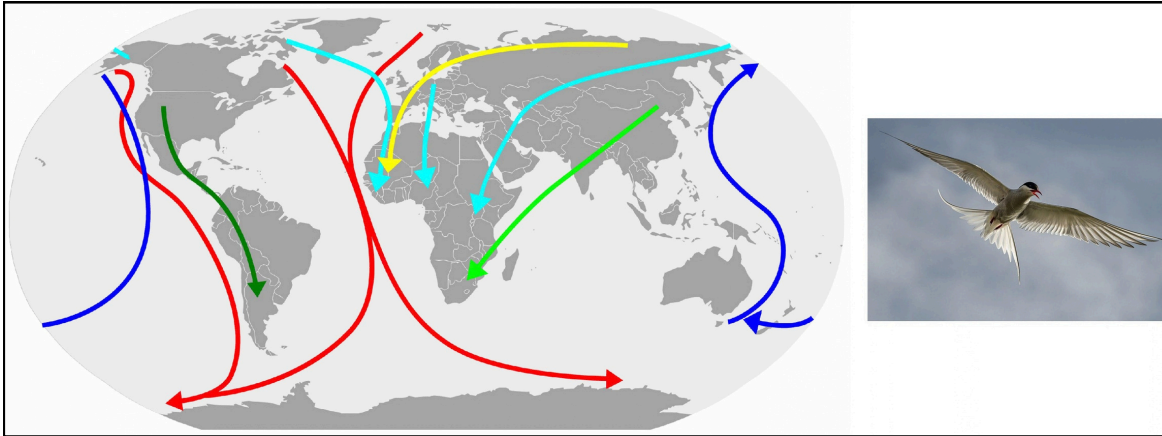


As snow deepens in the high country, thousands of elk descend to the National Elk Refuge to survive the winter cold. When the warmth of spring returns, they journey back to the open meadows of Grand Teton and the Bridger-Teton forests.

Credit: By USFWS Mountain Prairie - Elk Migration, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=162947180>

- Feathers are their armor. Oiled outer layers shed snow and water, while soft down beneath traps insulating air.
  - Fluffing up means warming up. A puffed-up chickadee at your feeder isn't fatter. By fluffing its feathers, it's creating thousands of air pockets to hold heat.
  - They share warmth too. Bluebirds and wrens huddle in tree cavities at night, pressing together to stay alive.
  - And when it's too much, they fly away. Arctic terns migrate farther than any creature on earth, from pole to pole (averaging 24,000 miles or 40,000 km), chasing an endless summer.
  - Tiny tricks keep them going. Birds tuck bills under wings and stand on one leg to conserve heat, while constant feeding fuels their internal furnace.
- Birds show that even the lightest among us can weather the heaviest cold through motion, ingenuity, and a bit of fluff.

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The Arctic tern, pictured at right, follows the planet's longest migration—up to 40,000 miles from the Arctic to the Antarctic and back each year. This map shows the tern's route (Red) among five other species, each migrating to find the warmth and food needed to survive seasonal cold. (Dark Blue - Short-tailed Shearwater (*Puffinus tenuirostris*); Dark Green - Swainson's Hawk (*Buteo swainsoni*); Yellow - Ruff (*Philomachus pugnax*); Pale Blue - Northern Wheatear (*Oenanthe oenanthe*); Pale Green - Amur Falcon (*Falco amurensis*).

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## Fish: Beneath the Ice

- Under a frozen lake, life moves in slow motion.
  - Cold-blooded fish match their world. As temperatures drop, they drift to deeper, slightly warmer water, slowing their heartbeat and metabolism almost to a standstill.
  - Many hide in place. They slip into rock crevices, hollow logs, or mud, safe from currents and predators.
  - Others adapt chemically. Arctic char and Antarctic icefish produce antifreeze proteins in their blood to keep ice from forming in their veins. We explored this remarkable adaptation in another EarthDate story, [Why Fish Don't Freeze](#).
  - Some even break the rules. The opah, a deep-sea predator, circulates warm blood through its body, the only known fully warm-blooded fish.
- And when food and oxygen run low, most wait quietly in a suspended calm until sunlight softens the ice above. In these still, dark waters, survival means slowing life's rhythm to the faint beat of winter.

## EarthNote: Life Beneath the Ice

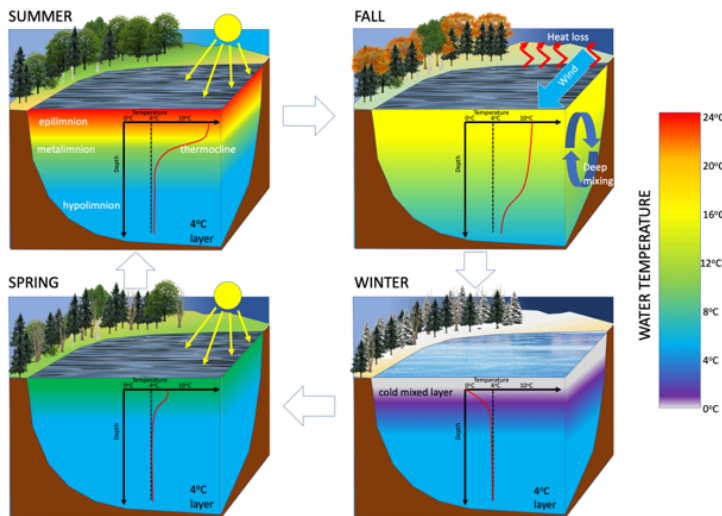
When winter settles in, a lake transforms into a layered world beneath a frozen lid. The surface ice, at 0 °C (32 °F), seals the lake from the air above, cutting off the usual exchange of gases. Below it lies a thin layer of water just above freezing, while at the bottom, the water is a steady 4 °C (39 °F)—the temperature at which water is most dense. This unusual property allows ice to float and prevents the lake from freezing solid, creating a cold but livable refuge for aquatic life.

Trapped under ice, sunlight weakens, and photosynthesis slows, so less oxygen is produced by aquatic plants and algae. Meanwhile, bacteria continue decomposing organic matter on the lake floor, consuming what oxygen remains. Over time, oxygen levels fall, especially near the bottom, where decomposition is strongest.

By late winter, this imbalance can trigger winterkill—a sudden die-off of fish and other aquatic life that run out of oxygen before the thaw. When spring arrives, melting ice and brisk winds mix the water column once again, restoring oxygen and bringing the lake back to life.

Even beneath a frozen surface, density, chemistry, and biology are in quiet motion—reminding us that the stillness of winter hides a complex, living balance below the ice.

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Salamanders survive winter in different ways and in different worlds. The small spotted salamander, just a few inches long, escapes freezing by burrowing deep below the frost line in moist soil. The much larger mudpuppy, over a foot in length, remains active beneath the ice. Its bright red external gills draw oxygen from cold, clear water, allowing this fully aquatic salamander to thrive even in midwinter.

Credit-Left: By Kristof Zyskowski & Yulia Bereshpolova -

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## Amphibians: Frozen but Not Gone

- On land, frogs and salamanders face a more extreme fate.
  - When the ground freezes, so do they. The wood frog adapts by making its heart stop and its body frozen solid as explained in the EarthDate episode Frogsicles.
  - Yet inside, life endures. Glucose and urea flood their cells, preventing ice crystals from piercing delicate structures.
  - When spring warmth returns, so does the heartbeat. Within minutes of thawing, they hop back to life as though nothing happened.
  - Other amphibians take refuge underground or remain as larvae underwater, sleeping through the season until the world warms again.

- These small, fragile creatures remind us that survival sometimes means surrender, enduring cold, deathlike stillness to awaken renewed solar energy.

## Survival Strategies for Winter Cold

- From shaggy coats to frozen hearts, the animal kingdom reveals countless ways to defy winter. Each species faces the same relentless adversary, the cold. And each has evolved a unique response.
- Yet in every case, life finds a way: slowing, huddling, migrating, or transforming.
- And when spring sunlight finally returns, the frozen world stirs once more, proof that warmth can come from within.

## References: Surviving the Cold

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The Winter Lives of Salamanders | [Northern Woodlands](#)

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Fact Sheet:  
Episode ED 502