

Polar Bears and Penguins

Background Information

How Cold is Cold?

When asked to describe polar climate, the first thing anyone says is **COLD!** Because of the tilt of the earth's axis, the poles are each tipped away from the sun for half the year. This results not only in very cold winters, but also earns them the nickname "lands of the midnight sun." In the summer, the north pole is tilted toward the sun, giving it constant sunlight. The south pole is in darkness. In the winter, the south pole is tilted toward the sun, and the north pole is in darkness. This happens at about 66° latitude, which defines the polar regions.

Within the arctic circle, home of the polar bear, there is only tundra and the Arctic Ocean. The north pole itself is not on land, but under great sheets of permanent, frozen sea ice, known as the polar ice cap. This ice extends to and largely covers the surrounding land, permanently, in many areas. In the winter, the temperature easily reaches -50°F, and averages -30°F. Throughout the year, the arctic only averages about 7°F. The summer isn't much warmer, with an average temperature of 29°F, but in July, temperatures soar to nearly 50°F. The thaw allows the land to absorb more heat from the sun, allowing a brief growing period for the grasses, sedges, lichens, mosses, and shrubs. Even with this period of warmer temperatures, the ground does not completely thaw, resulting in permafrost. Because of this, trees do not grow within the arctic circle – they cannot put down roots deep enough to sustain them.

Antarctica, home to penguins, has the distinction of being the coldest, windiest, highest, driest, iciest continent on earth. It holds the world record low temperature of -129°F, with an average year-round temperature of -56°F. Normal temperatures in summer fall between -5°F and -31°F, and are -40°F to -94°F in winter. Ninety-eight percent of the continent is covered by permanent snow and ice, which is up to 15,668 feet deep – the thickest on the planet. This leaves very little area for plants to grow. There are no trees or shrubs – only mosses, lichens, liverworts, and a very few grasses.

So, why is Antarctica so cold? Several factors come into play. Since Antarctica is a continent, the interior does not get any warming effect from the water, as the arctic does. The thick ice cover reflects, rather than absorbs, most of the solar energy it receives. During the winter, Antarctica's size nearly doubles as the sea ice freezes, blocking any heat transfer from the warmer, surrounding oceans. More heat is lost due to the extreme dryness of the air (less than 0.03%). Heat is radiated back into the atmosphere instead of being absorbed by the water vapor in the air. This also gives Antarctica less than 1 inch of annual precipitation, making it the driest desert on earth. With an average elevation of 8200 feet, higher than any other continent, altitude results in colder temperatures. Also, the katabatic winds from the higher elevations in the middle of the continent sweep across the coasts at up to 200 mph, creating wind chills in excess of -150°F!

Famous Fauna

Of all the animals that live in the polar regions, the most widely known are the polar bears and penguins.

Polar bears are found throughout the arctic circle. They are the largest carnivore on land. Males (boars) can grow to be twice the size of females (sows), weighing in between 750 and 1,500 pounds, and measuring 8 – 10 feet long. Females weigh about 330 – 550 pounds, and measure 6 – 8 feet long. The largest ever recorded was a male 12 feet long and weighed 2,209 pounds. Their feet are very large (up to a foot in diameter), and act like snowshoes to keep the bear from sinking into deep snow drifts.

Penguins are found throughout the Southern Hemisphere, primarily on and around the continent of Antarctica, but also along the southern coasts of Africa and Australia, around New Zealand, the

Falkland Islands, and both coasts of South America. One species can even be found along the equator on the Galápagos Islands. There are 17 species of penguins, ranging in size from the tiny fairy blue penguin, standing 16 inches tall and weighing 2 pounds, to the impressive emperor penguin, standing nearly four feet tall and weighing 66 pounds. Penguins are primarily black and white: black on their backs and white on their bellies. This color pattern is known as counter-shading. On land, they are extremely obvious, but in the water, their white bellies make them practically invisible to underwater predators. The black backs also promote heat absorption and can aid in temperature regulation in the frigid waters. The large penguins also have brightly colored ear patches. It is believed that these are used during the breeding season as a courtship display. Each species of penguins has unique markings, usually on the head, which make it easily recognizable.

Staying Alive: Survival Strategies

Because of these harsh conditions, polar bears and penguins have had to adapt in order to survive. There are a variety of physical features and behaviors that allow them to do so.

Insulation To survive such frigid conditions, keeping warm is extremely important. Polar bears and penguins must retain as much body heat as possible. Fur, feathers, and fat help them to accomplish this.

Polar bears have thick coats of hollow fur. The air pocket inside each hair helps to trap body heat next to the skin. Polar bear fur is also clear, allowing their black skin to absorb heat from the sun. If their fur was truly white, it would reflect the heat, greatly reducing the bear's ability to stay warm. Oil makes the fur water repellent and keeps it from matting, allowing them to shake off any snow or ice that forms on it after swimming. Polar bears are the only bears to have furry feet. The hairs around their pads not only keep their feet toasty warm, but also provide traction on the ice.

Penguins have a waterproof coat of short, densely-packed feathers (about 70 feathers per square inch). Their feathers, unlike most other birds, do not have an outer layer of flight feathers and an under layer of downy feathers. Instead, these two layers are combined. The lower portion of the feather is downy, while the upper portion is stiff, like a flight feather. This top portion, when coated with oil from a gland at the base of the tail, forms a protective shell that locks heat in and water out.

Penguins and polar bears also have another layer of insulation – blubber. Blubber is a thick layer of subcutaneous fat. Polar bears have about 4 inches of blubber, not only protecting them from the cold, but also adding buoyancy, and acting as a reserve in times when food is scarce.

This insulation is so good that overheating can be a problem. To eliminate excess body heat, penguins will lift their feathers and pant. They also radiate heat from the underside of their flippers, their feet, and, for some species, from patches of bare skin usually found around their eyes or beaks. Some, like the Galápagos and Fairy penguins, also seek out shade under vegetation or in underground burrows where they are also protected from predators. Polar bears try to avoid overheating by moving slowly and resting often. If they do overheat, they radiate excess heat in areas without fur (nose and foot pads) or where blood vessels are close to the skin (ears, shoulders and inner thighs). They will also swim to cool off.

Super Swimmers While the thought of diving into icy waters may send shivers down our spines, both polar bears and penguins are very much at home in the water. Polar bears' front paws are large, round, and partially webbed. They use them to paddle through the sea at about 6 mph, often for hours at a time and over long distances (up to 62 miles, nonstop). The hind legs are held out behind their bodies, acting as rudders. They may make shallow dives (to about 15 feet) when stalking prey, looking for kelp, or navigating ice floes. When they do, their nostrils close, helping them to stay submerged for up to two minutes.

Penguins are unable to fly, but are outstanding swimmers. Their torpedo-shaped body, webbed feet and strong, stiff flippers allow them to "fly" gracefully and swiftly through the water. They can be seen

porpoising along the surface, allowing them to breathe on the go and possibly confusing predators. On land, their waddling gait is due to their leg placement far back on their bodies, which aids enormously in swimming. The most efficient way for them to travel on land is tobogganing on their bellies, propelling themselves with their flippers and feet, using their claws for traction. Penguins are also remarkable jumpers. To escape aquatic predators such as leopard seals, orcas, and sharks, they will jump out of water onto pack ice and ice floes. Adélie penguins are able to leap 4 to 5 feet straight up out of the water, and Rockhoppers got their name from their ability to climb very steep cliffs by hopping from one rock to another, covering as much as 6 feet in one jump.

Finding Food To maintain their layer of blubber, both polar bears and penguins must have a steady supply of food. Polar bears need at least 4.4 pounds of fat a day just to survive. They use their keen sense of smell to locate seals under three feet of ice, which they catch with their sharp teeth and claws. One seal can provide enough food to last the bear about a week. Polar bears will also hunt smaller whales (like belugas) and young walrus. If these food sources are not available, polar bears will eat just about anything they can find, including reindeer, fish, seabirds, small rodents, plants (including kelp), and even human garbage. Before the harsh winter months, females (especially pregnant females) will create a snow den (usually in October). Once inside, they will enter a resting state called torpor. During this time, body temperature drops and body processes are slowed down. A female polar bear fasts during this time, using the fat reserves she put on during the spring and summer. She spends most of her time sleeping, but may be easily roused, if disturbed.

Penguins feed primarily on fish, squid, and krill, a small, shrimp-like animal that is plentiful in the Antarctic waters. Food is swallowed whole, often while on the move. To help them swallow their prey, penguins have stiff, bristle-like structures in their throat. These bristles point backwards, allowing food to move down their throat, and preventing still-living prey from wriggling back out.

Family Time Because food is scarce in the arctic, polar bears live mainly solitary lives. The exception is a female rearing her cubs. Cubs, usually twins, are born in the snow den during the early part of the female's winter torpor. They are born small, weighing only 1-2 pounds, blind, and with only fine hair covering their bodies. They are completely helpless, relying on their mother for food and warmth. When they emerge from the den in March or April, the cubs will weigh 10 – 15 pounds. The female will lead them to the sea ice and teach them how to hunt. The cubs will stay with the female for about 2 ½ years, until they are ready to survive on their own. At that time, she will be ready to breed again and raise a new family.

Penguins are very social birds. After spending months feeding in the ocean, penguins come together in large breeding colonies called rookeries. These vary greatly in size from a few scattered pairs to millions of penguins, with groups of 40,000 or more being the norm. After mating, the female penguin lays her eggs. Most penguin species lay two, but the King and Emperor penguins lay only a single egg. They are usually laid in a nest. Adélies build rock nests; Magellanic, Galápagos and other warmer climate penguins nest in underground burrows. Emperor and King penguins build no nest. After the egg is laid, the female passes it to the male. He incubates the egg on his feet and covers it with his brood patch, a bare patch of skin on his belly that allows his body heat to be transferred to the egg. The female then goes out to sea to feed until the egg hatches, leaving the male to care for the egg alone.

This is an especially difficult ordeal for the male Emperor penguin, who incubates the egg during the coldest part of the Antarctic winter. During the nine weeks it takes for the egg to hatch, the male is unable to feed, and loses approximately 45% of his body weight by the time the female returns. Despite this, should the female be late returning from the sea, the male is able to produce an oily "milk" from his crop to nourish the chick until she does return.

After the eggs hatch, the female penguins return from the sea. The male penguin transfers the chick from his feet to the female's feet, then goes to feed and regain his strength. This transfer must be done quickly, or the chick will freeze. After a few weeks, their coat of fluffy feathers is thick enough to protect them from the cold. Their demand for food is now so great that both parents must go to sea to find food for the chicks. They are left in large groups, called crèches, while the parents are at sea. The returning parents are able to locate their chick from among the hundreds or thousands of others by the sound of their voice. They call to the chicks, and the chicks respond. The parents will regurgitate the food they have collected for the chick to eat.

The chicks are completely dependant on the parents for food and protection. Their feathers, though wonderful insulators, are not waterproof and would quickly become waterlogged. Chicks that fall into the water often drown, freeze, or fall prey to leopard seals, orcas and sharks. Parents must also guard against predators on land, like skua birds and Sally Lightfoot crabs (in the Galápagos) that will go after unprotected chicks and eggs. After about 2 or 3 months (14+ months in the case of King penguins), the chicks molt and their adult feathers come in. They are then able to fend for themselves.

Cause for Concern

The polar regions of the planet are beautiful, but delicate, ecosystems. Because of the extreme conditions, the survival of the animals and plants are intricately connected to one another and to the land and sea around them. Global climate change is shrinking the polar ice caps and affecting the location, thickness, and duration of the sea ice. This impacts the ability of polar bears to hunt, affects the breeding grounds of penguins, and causes habitat loss for these and many other species that share their home. Drilling and other human activity affects migration routes, sometimes cutting animals off from inland summer feeding and breeding grounds. Pollution and over fishing impact important food sources.

What Can I Do?

Legislation like the Marine Mammal Protection Act and the Endangered Species Act offer some protection to these animals and their habitat, but your actions at home can make a difference, too. Using fewer petroleum products like gasoline and plastics can reduce the overall need for drilling. Carpooling, using public transportation, and recycling are all ways to lessen your environmental impact. Conserving energy, water, and other natural resources whenever possible is a great way to have a positive effect.

Polar Bears and Penguins **Suggested Student Reading**

Antarctica by Helen Cowcher

Borealis: A Polar Bear Cub's First Year by Rebecca L. Grambo

Cold Paws, Warm Heart by Madeleine Floyd

Counting Penguins by Betsey Chessen and Pamela Chanko

The Emperor's Egg by Martin Jenkins

A Home on the Tundra by Katie Marsico

Kumak's House: A Tale of The Far North by Michael Bania

Little Mo by Martin Waddell

Little Penguin by Patrick Benson

Little Penguin's Tale by Audrey Wood

Little Polar Bear by Hans de Beer

Mr. Popper's Penguins by Richard and Florence Atwater

Polar Bear by P. Adams

A Polar Bear Journey by Debbie S. Miller

Polar Bear, Polar Bear, What Do You Hear? by Bill Martin Jr. and Eric Carle

Polar Star by Sally Grindley

See How They Grow: Penguin by Mary Ling

Snowflake the Polar Bear by Judy Ross

Who Lives in the Arctic? by Susan Canizares and Pamela Chanko

Teacher Resources and Reference

Arctic Wildlife by Monte Hummel

Looking at Penguins by Dorothy Hinshaw Patent

People of the Ice: How the Inuit Lived by Heather Smith Siska

The World of the Polar Bear by Thor Larsen

Polar Bears and Penguins

Vocabulary

adaptation – behavioral or physical feature that improves a plant or animal’s chance for survival in its habitat

blubber – thick, insulating layer of fat under the skin of many polar animals

camouflage - an organism's ability to hide or blend in with its surroundings using color, pattern or shape.

conservation – the wise use of natural resources in order to ensure continued availability to future generations

ecosystem – an ecological community together with its environment, functioning as a unit

glacier – a huge mass of ice formed from compacted snow that flows over a land mass

fast ice – sea ice that is attached to land; also called land-fast ice

habitat - the place an animal lives. It provides the animal with shelter, food, water, and air/space.

ice floe – chunks of floating sea ice that is less than 6 miles across; sea ice chunks larger than this are called **ice fields**

insulator – something that acts to keep heat inside the body, such as fur, feathers, or blubber

pack ice – large masses of floating sea ice

polar region – areas surrounding the north and south poles, above 66° latitude, that have very cold temperatures, have at least one day where the sun does not set (summer) or rise (winter), and experience auroras

predator - an animal that kills and eats other animals.

prey - an animal that is hunted or killed for food.

sea ice – frozen sea water. Because of the salt content, this happens at 28.8°F.

tree line – altitude or latitude above which trees do not grow

Polar Bears and Penguins

Journey to the Poles

Pre-Visit Activity

Content Area: Geography, Language Arts, Science

Skills: listening, critical thinking, fine motor

Objectives:

- TSW locate the poles on a globe.
- TSW describe the climate at the poles.
- TSW decide what equipment to take on a polar expedition.

Materials: globe, Who Lives in the Arctic? by Susan Canizares and Pamela Chanko and/or Antarctica by Helen Cowcher, Background Information, "Journey to the Poles" Student Page, scissors, glue

Procedures:

Anticipatory Set:

Read one or both of the stories. Where are these set? In the polar regions! Look at the pictures. What do you think the weather is like? Cold! It is much colder at the poles than it is at home. This is because of where the poles are.

Development of Lesson:

1. Use the globe to locate the north and south pole. Explain that the earth tips the poles away from the sun for about half the year, and toward the sun for the other half. This means that for half the year it is dark, and for half the year it is light. This gives the poles the nickname "Lands of the Midnight Sun."
2. It also means that the polar regions only get heat from the sun for a short time each year. A summer day at the north pole only gets to about 50°F (a chilly fall day), and only about -5°F at the south pole – that's below zero!
3. Look at the pictures again. Are there any trees? No. The polar regions are above the tree line – that means that they are too far north for trees to grow. Part of the ground stays frozen year round – called permafrost – that keeps tree roots from going deep. Instead, there are grasses, mosses, lichens, and bushes (in the arctic).
4. Show the last page of Who Lives in the Arctic?. People live in the arctic. Would it be easy to live there? Why or why not? (hard to find food, shelter, stay warm, etc.)
5. People have been interested in finding out what it is like in the polar regions for a long time. Many people have made trips to explore them. These explorers had to take everything they needed with them.
6. Pass out the student pages. Let's imagine that we were going on a trip to the polar regions. What sort of things would we need to take with us? Have the students cut out the things they would take and glue them in their sled.

Summary:

Discuss the things they put in their sleds. Why did they choose those things? Is there anything that they did not need to take? Why not? What else would they take? Why?

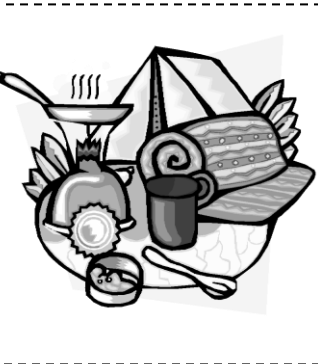
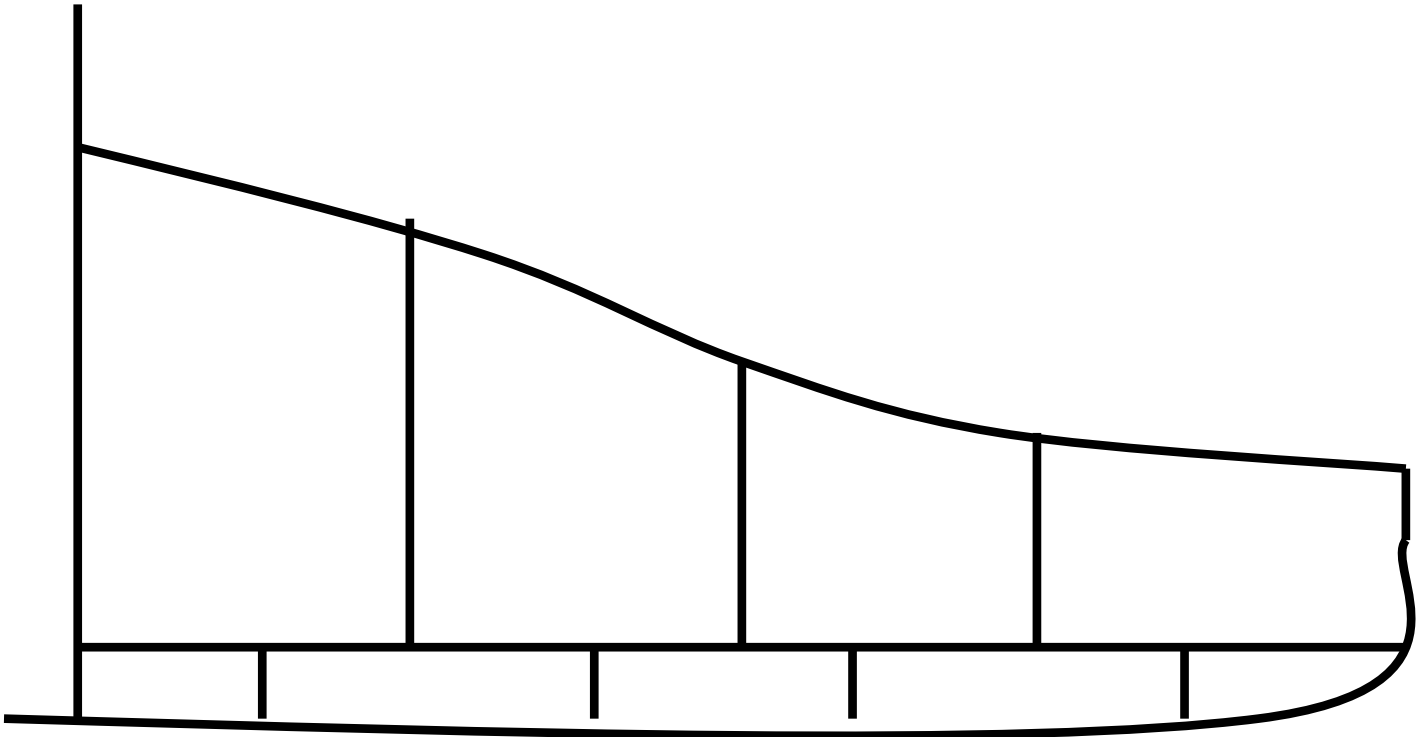
Extension:

- Write a story about a trip to the polar regions! Share them with the class or publish them and put them in the library to share with other students.

Name _____

Journey to the Poles

What do you need to go to the polar regions? Cut out the things you will take and glue them in the sled.



Journey to the Poles

Answer Key

Sled dog – a great way to get around. Dogsled is the preferred mode of transportation in the remote areas of the polar regions. Gas stations are few and far between in the polar regions, and many areas are inaccessible except by dogsled or air transport.

Sunscreen – it may seem strange, but sunscreen is a good thing to have at the poles, especially if you are there during the summer. You have 24 hour exposure to the sun's rays. Sunscreen will help to protect your skin. Be careful, though. Sunscreen stops being effective if it has been frozen.

Parka and snow boots – you definitely need to bundle up against the cold! Even in the summer, temperatures are still very low, especially in Antarctica!

Sunglasses – like sunscreen, a surprisingly good idea. Native Inuits wear goggles made from caribou antler that have a very narrow slit to let in just enough light to see. These “sunglasses” keep the glare from the snow out of their eyes. Continued exposure to the brightly reflected light can result in a condition known as snow blindness. Snow blindness is like a sunburn to the cornea of the eye which, in severe cases, can result in permanent damage and/or loss of vision.

Camping gear – there is little to no shelter available at the poles, so you must bring it with you. Without appropriate gear, you would freeze.

Bathing suit – sorry, no swimming pools at the poles!

Camera – scientists always want to document their findings! This is one way to make a record of your trip. Early explorers kept journals, too.

Polar Bears and Penguins

Fur, Feathers, and Fat

Post-Visit Activity

Content Area: Science

Skills: comparing, sensory, verbal

Objectives:

TSW identify fur, feathers, and blubber as ways polar animals stay warm.

TSW define *insulator* as something that keeps heat inside the body.

TSW conduct an experiment to compare having fur, feathers and blubber to bare skin.

TSW compare the way fur, feathers, and blubber work as insulators.

Materials: zip-lock type sandwich- and gallon-sized baggies (**NOT** the easy-zip type), craft feathers, poly-fill, shortening, stapler, duct tape, plastic tubs, ice cubes or snow, water

Procedures:

Before You Start:

Make insulator gloves:

1. Take the sandwich sized bag and add about 1 c. of shortening. DO NOT get shortening on the outside of the bag. Note: if you are going to have this set up in your room for several days as a discovery station, use a heavy freezer bag or it may break open and you will have a big mess!
2. Take another zip-lock bag and carefully turn it inside out. Be careful not to tear the sides as you do this. Put it inside the first bag, aligning the male and female sides of the zip-locks. DO NOT get shortening on the inside of the bag.
3. Zip the bags together. Reinforce the top with staples, if necessary, **ABOVE THE ZIP-LOCK ONLY**, smooth side of the staple facing out. Cover the top edge with duct tape, cuff the top, and reinforce again with duct tape.
4. Distribute the shortening inside the bag, making sure that the bottom and sides are covered.
5. Repeat for feathers and fur (poly-fill), using the gallon-sized bags.

Fill your tub with snow or ice water.

Anticipatory Set:

Review the climate in the polar regions. How do animals stay warm? Penguins and polar bears use a combination of fur or feathers and blubber. These work as *insulators* – they help keep the heat inside their bodies.

Development of Lesson:

1. Look at your hand. Do you have fur, feathers or blubber? Predict: what will happen if you put one hand in snow by itself and one hand in the blubber glove in snow? Try it!
2. Repeat for the fur and feather gloves.
3. Predict: what happens if you put blubber and fur together? Try it! Put the blubber glove inside the fur glove, then into the ice water or snow. Is it warmer than just one of the gloves by itself?
4. Repeat for blubber and feathers.

Summary:

Discuss what they found. Which was warmer, your hand or the gloves? Which one glove do you think made the best insulator? What about when you put them together? What glove or pair of gloves made the best insulators of them all?

Extension:

- Look at your winter clothes. How are they different from your summer clothes? What do they use as an insulator?