EXPLORING THE NORTH

Learning objectives

- Students will use previous knowledge to define what the Arctic looks like in different seasons.
- Students will discover the importance of the Canadian Arctic by brainstorming its symbols, languages, climate and biodiversity.
- Students will examine 16 arctic specimens from the Canadian Museum of Nature's collection and connect it to the arctic environment.

Time required

30-40 minutes

Grades

3-12

Materials

- Arctic brainstorm worksheet (attached)
- Arctic specimen cards (attached)
- Arctic specimen worksheet (attached)
- Tiled Map of Canada (education.canadiangeographic.ca)
- Copy of *Canadian Geographic*'s article "Fine Specimens", pages 55 to 59 (optional)
- Internet access (optional)

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Introduction

Have students complete the Arctic brainstorm worksheet. Discuss students' answers and see if there are any patterns in their views of the Arctic. Have students write a list of what they would like to learn more about on the worksheet.

Development

Explain that the Arctic is vibrant and full of life. Although many people perceive it as a barren region full of snow, the Arctic is rich in biodiversity, resources and culture. The Canadian Museum of Nature, located in Ottawa, Ontario, houses one of the largest collection of Arctic flora and fauna in the world. Each year, scientists from the museum travel to Canada's Arctic and conduct research in one of the museum's four main disciples: palaeobiology (the study of fossils), botany (the study of plants), mineralogy (the study of rocks and minerals) and zoology (the study of animals). Distribute the Arctic specimens worksheet and define all four disciplines together as a class and have students record these definitions.

Next, distribute the Arctic specimen cards to the class. If more than one set of cards has been printed, divide students into groups and have each group examine its own set. As students examine their specimens, have them determine which discipline it fits in and record the species' name on the worksheet. Once all 16 specimens have been examined and divided into their appropriate disciplines, have students choose the one specimen they found most interesting and complete the bottom of the worksheet, explaining why this specimen is important and how it helps us understand the Arctic. Have students come up with a question they have about this specimen and visit the museum's website (nature.ca) to find the answer. Finally, have students share their ideas with the rest of the class explaining why they selected the specimen they did.

Conclusion

In the January/February 2015 issue of *Canadian Geographic*, "Fine Specimens" references an interview with Jennifer Doubt, Canadian Museum of Nature's Botany curator, who states:

"...there is an urgent need to study the Arctic today, since climate change is altering the region more quickly than any other place on Earth, while melting is uncovering new clues about how life responded to past climatic upheavals and migrations."

Divide students into small groups and have each discuss what the they think the scientist meant. Ask students how they feel about this comment and to think about what changes they may see in the Arctic in their lifetime. Next, have students reflect on their Arctic specimen worksheet and predict the challenge that Arctic species may face as the Earth's climate continues to warm.

Extend your geographical thinking

Collect all of the specimen cards and invite one student volunteer to randomly choose a card and hide it from the rest of the class. Explain that the volunteer must think of three first-person sentences (e.g., I can be found in water, I live on land, etc.) to best describe their specimen without saying to which discipline their specimen belongs. After each sentence, allow time for students to guess the specimen. Have the first student who guesses correctly select the next card.

A great way to extend your Arctic learning is to reserve the Arctic Alive giant floor map at education.canadiangeographic.ca. This resource is available on loan for a period of three weeks and is completely free of charge.

Set-up

Print out one Arctic brainstorm worksheet for each student and enough sets of the Arctic specimen cards for your class. If available, hang a map of Canada in your classroom, use the Tiled Map of Canada or project one on the board to show the location of the Arctic.

Links to the Canadian National Standards for Geography

Essential Element 1: The World in Spatial Terms

- Location of major human and physical features on Earth
- Distribution of major human and physical features at country and global scales

Essential Element 2: Places and Regions

- Perceptions of places and regions
- Regions defined by multiple criteria
- Changes in places and regions over time
- Political and historical characteristics of regions
- Regional analysis of geographic issues and questions

Essential Element 5: Environment and Society

- Human adaptation to the physical environment
- Limits and opportunities of the physical environment for human activities
- Global effects on the human environment by changes in the physical environment

Name: _____

ARCTIC BRAINSTORM WORKSHEET

What is the Arctic?

What we know

What we want to know

What can you find there?

(Plants/animals/people)

Symbols

Describing words

Why is the Arctic important?

What is the Actic like in the

SPRING	
SUMMER	
FALL	
WINTER	

Name: _____

ARCTIC SPECIMEN WORKSHEET

Specimens

AMPELISCA MACROCEPHALA
ARCTIC COD
AULACOMNIUM TURGIDUM
BEAVER
DIAMOND
DRYAS INTEGRIFOLIA
GALENA
GORMANITE
ICE
MOSQUITO
MUSKOX
PLIOCENE CAMEL
PUIJILA DARWINI
RHIZOCARPON GEOGRAPHICUM
THALASSIOSIRA NORDENSKIOELDII
TIKTAALIK ROSEAE

Palaeobiology	Botany	Zoology	Minerology

Specimen

_____

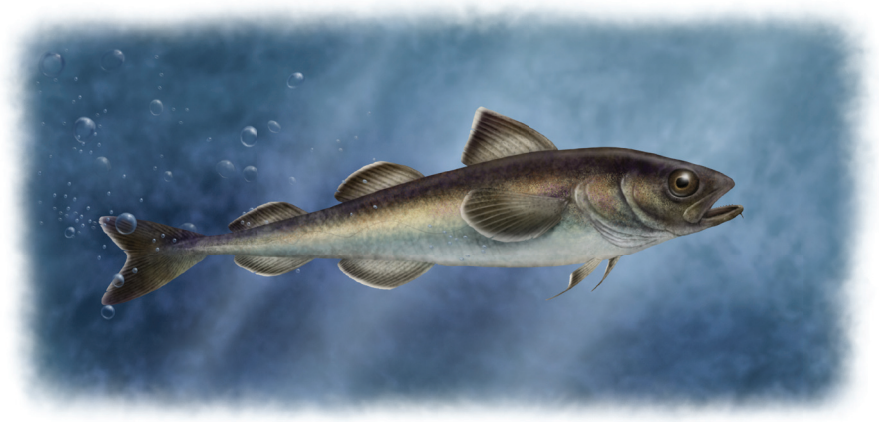
is important because...

MUSKOX

MUSKOX — OR *OMINGMAK,* as the Inuit call this Arctic herbivore — are well adapted to the Arctic, both physiologically and behaviourally. Distributed throughout much of Canada's High Arctic in small herds of roughly 20 individuals, muskox thrive in the region's extremely dry, cold conditions, grazing on low-lying grasses, mosses, Arctic willows and shrubs. With their compact bodies and long hair that covers a soft, dense undercoat, they preserve even more warmth through harsh winters by huddling together and sharing body heat. The Inuit have relied on muskox for millennia, using the meat for sustenance, fur for warm coats and skull and horns to carve into works of art.

AMPELISCA MACROCEPHALA

FORMING HUGE, DENSE BEDS on the sea floor —sometimes up to 16,000 individuals per square metre — Ampelisca macrocephala are a major food source for everything from diving seabirds to grey whales, which scoop up vast quantities within their massive jaws. Described as "filter feeders" because they consume tiny food fragments that sink from the surface, Ampelisca produce silk from their legs so they can latch onto food particles. Most of the museum's preserved specimens are from Cape Bathurst in the Beaufort Sea, where prevailing currents create an upwelling of cold, nutrient-rich water, which mixes with surface water — an ideal scenario for the zooplankton and phytoplankton that provide their sustenance.



ARCTIC COD

SWIMMING IN MASSIVE SCHOOLS throughout the entire circumpolar region — from northern Russia and Greenland to Alaska and Canada — Boreogadus saida, or Arctic cod, is distinguished from other types of cod by its forked tail and protruding mouth. A sleek, slender fish that grows up to 30 centimetres and feeds on plankton near the surface, it's another major link within the Arctic food chain, providing a steady diet for seals, seabirds and beluga whales. With antifreeze proteins in its blood to stave off the cold, Arctic cod is one of the few fish on the planet that can thrive in sub-zero temperatures.

MOSQUITO

YOU MIGHT THINK mosquitoes only frequent forested landscapes, where swamps and freshwater lakes abound. But after the Arctic snow melts, in those few short weeks or so of warm temperatures, the tundra is like a sopping sponge in standing water, partly because an impervious permafrost layer impedes excess water from draining away. The conditions are tailor-made for breeding mosquitoes, which have been known to turn the sky grey as they swarm for sweet nectar and blood in the region. Where the caribou herds roam, the voracious insects can suck up to 300 millilitres of blood from each animal every day. Imagine that the next time you're swatting bugs on your back porch.

ICE*

ICE IS FOREVER SHAPING the Arctic landscape. It may seem immobile, but it's constantly shifting, receding and melting. And every time it changes form, ice affects all other Arctic features — from the surface rock it scrapes under constant pressure to the organisms that traverse its slippery slopes, pursuing prey or fleeing predators. More melting ice in the Arctic is a harbinger for accelerated warming to come. The amount of Arctic sea ice has been declining for decades, as ancient glaciers melt, break off into icebergs and open up new shipping lanes that didn't exist when this country was born. **[Naturally occurring ice meets the five requirements of a mineral substance, and can thus be considered a mineral. — Ed.]*

GALENA

A SHINY AND METALLIC lead-sulfide mineral, galena is a major ore used in the production of lead, and is found alongside large zinc deposits in Canada's North. Two large mines processed galena in Canada's Arctic until they were both closed in 2002 because of declining resources: Baffin Island's Nanisivik mine, which opened in 1976 as Canada's first Arctic mine, and the Polaris mine, on the southern tip of Little Cornwallis Island, the most northerly base-metal mine in the world when it was shut down.

DIAMOND

THE DIAMONDS IN CANADA'S ARCTIC formed millions of years ago, as a carbon compound crystallized under searing heat and pressure deep below the surface, then bubbled up in magma flows from long-extinct volcanoes. As these formations cooled, they left diamond-laced rock formations — called kimberlite pipes — closer to the surface. Canada's major diamond mines, which have propelled the country into the top 10 diamond producers in the world, sit atop these key formations. Most are in the Northwest Territories, where the Diavik, Ekati and Snap Lake mines operate, and another, the Gahcho Kué project, is being developed. Other diamond mines include Nunavut's currently dormant Jericho mine and northern Ontario's Victor mine, near James Bay.

GORMANITE

MINING IN THE YUKON is about far more than the Klondike gold rush of the late 1800s. In the last few decades, several new minerals have been discovered in northeastern Yukon, between Rapid Creek and Big Fish River, and west of the Mackenzie River delta. Named after Donald "Digger" Gorman, who first discovered it in 1981, gormanite is a bluish-green mineral that appears in a radial-spray form on fractured rock surfaces — so-called fracture fillings — in phosphate-ironstone rock formations. Although it has little economic value, gormanite is considered a collectors' item, partly because of its rarity throughout the world.

PLIOCENE CAMEL

IF YOU GET A CHANCE to see the fossilized tibia of an extinct giant camel in the museum's research and collections facility, you might easily mistake it for an old hunk of wood. But the 30 leg-bone fragments — found on a steep, sandy slope near Strathcona Fiord on the west-central side of Nunavut's Ellesmere Island — are actually the most northerly evidence of the earliest camels, which originated in North America more than 45 million years ago. Collagen from the bone indicates it most closely matches modern one-hump camels and the Yukon giant camel, thought to be the ancestor of modern camels. The fossils are about 3.4 million years old, which means these camels lived alongside the beavers and other boreal creatures found at a nearby site called Beaver Pond (see "Beaver," bottom).

TIKTAALIK ROSEAE

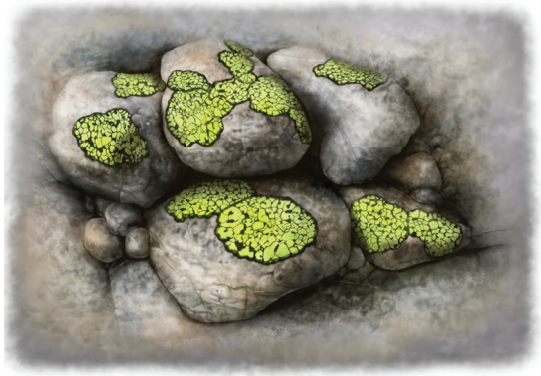
ANOTHER RARE MISSING LINK, *Tiktaalik roseae* has been called a "fishapod" because this extinct species helped scientists fill the evolutionary gap between fish and four-legged animals (tetrapods). Discovered in 2004 on southern Ellesmere Island in rock sediments formed by an ancient river system, *Tiktaalik's* fossilized remains date back 375 million years. At three-metres long, with a flat head and big jaws, *Tiktaalik* resembled a present-day crocodile. Its fins, which were strong enough to prop itself up on land, either in shallow water or along the water's edge, were on their way, in evolutionary terms, to becoming feet. When *Tiktaalik* lived, Ellesmere Island was much farther south, due to continental drift, and resembled a subtropical floodplain.

PUIJILA DARWINI

IT'S RARE FOR SCIENTISTS to uncover a new genus and species, rarer still when that extinct creature provides a crucial missing link in evolution. The fossilized remains of Puijila, which means "young sea mammal" in Inuktitut, were discovered in an ancient lake deposit on Nunavut's Devon Island by museum researchers in 2007. The bones were incredibly well preserved in the Haughton Crater — a 16-kilometre-wide impact site created by a meteor strike about 24 million years ago. An ancestor to modern seals, Puijila had legs that allowed it to hunt on land and an otter-like body and webbed feet for swimming in freshwater lakes.

BEAVER

BEAVERS IN THE TREELESS ARCTIC? It may seem hard to believe, but about three million to five million years ago, Canada's Arctic was much warmer than it is today and largely covered by a larch-dominated boreal forest landscape. At the Beaver Pond site on Ellesmere Island, Canadian Museum of Nature researchers found the fossilized remains of an extinct beaver, along with preserved wood that had been unmistakably gnawed by beaver teeth. The fossils were found in peat with molluscs and other plant matter, offering the scientists a treasure trove of material for studying the climate of that time, known as the Pliocene Epoch.

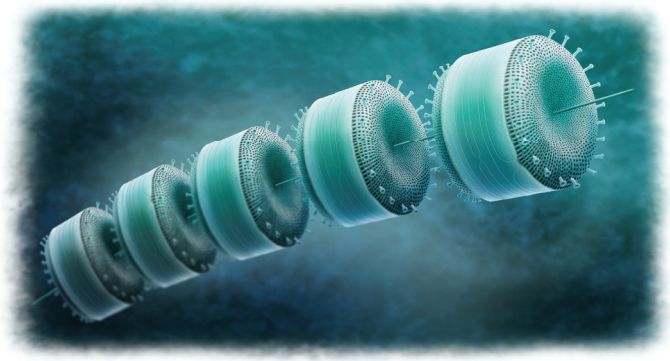


RHIZOCARPON GEOGRAPHICUM

RHIZOCARPON GEOGRAPHICUM IS often called the "map lichen" because it grows in patches bordered by black lines and, as a result, looks like a map with little rivers and roads. It's the original lichen used for lichenometry, a process that dates exposed rock and other surfaces. Since the lichen only grows at a fraction of a millimetre each year, lichenometrists can use the size of a lichen to date whatever surface it's growing on. *Rhizocarpon* is also an extremely tough organism that thrives in the most extreme Arctic environments. To test its toughness, researchers decided to take a colony into Earth's orbit, where it was exposed to empty space for nearly 15 days. It survived unharmed, of course.

AULACOMNIUM TURGIDUM

AULACOMNIUM TURGIDUM IS A VERY HARDY MOSS; so hardy, in fact, that researchers were recently able to bring some back to life after it had lain dormant for more than four centuries under the Teardrop Glacier in Nunavut. With its bright yellow-green colour and spongy texture, it's an attractive and distinctive High Arctic species that grows especially well in damp tundra landscapes. If you've ever felt the "springy" Arctic tundra under your feet, that's likely *Aulacomnium turgidum*. It's also found in isolated, remnant patches of alpine tundra, such as the Ouimet Canyon on the north shore of Lake Superior, near Thunder Bay, Ont., where it still remains after the glaciers retreated 10,000 years ago.



THALASSIOSIRA NORDENSKIOELDII

THIS UNICELLULAR ALGAE SPECIES (a diatom) is so tiny you need a microscope to see it. But despite its size, these and other common phytoplankton form the base of the Arctic's marine food chain. Wherever they float in northern waters, a feeding frenzy is sure to follow — from tiny crustaceans to the biggest whales. Like other diatoms, *Thalassiosira nordenskioeldii* is often said to live in "glass houses," because it resides within clear silica cell walls called frustules, which stay in the environment long after the organisms die. After sinking to the sea floor, the glass shells provide key physical evidence for researchers learning about earlier climates and conditions in which the organisms grew.

DRYAS INTEGRIFOLIA

LIFE IS NOT EASY for flowering plants in the High Arctic. In an urgent frenzy during the Arctic's short summer season, *Dryas integrifolia* (the mountain aven) and similar species have to grow, flower and then produce seed, all before winter returns. A member of the rose family, this plant's stem and leaves are fuzzy, creating a thin layer of still air that protects it from the Arctic's extremely dry, moisture-sucking winds. Inuit often called these plants *malikkaat*, or "the followers," because they follow the seasons: the flowers fold out in one direction when summer is coming, and twist and fold the opposite way for winter.