

Arctic Sea Ice Ecosystem Teaching Guide

A resource handbook for learning about Arctic ecology at home

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USGS



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About me

I am a professional zoologist with a Ph.D. who has studied polar bear ecology and evolution for more than 20 years, and walrus ecology and conservation for seven years. Since 2012 I have written a popular blog about polar bears past and present called www.polarbearsience.com. I have authored many peer-reviewed papers about different animals (including polar bears). My research interests include past and present aspects of Arctic biology and ecology.

I have written several science books about polar bears and two about walrus. In addition to my popular *Facts & Myths* series for elementary school children on polar bears and walrus described within this guide, I have also written a short, fully referenced science book about polar bears for adults and teens ([*Polar Bears: Outstanding Survivors of Climate Change*](#)) that's filled with useful color images in addition to more interesting facts. My two most recent books for adults are [*The Polar Bear Catastrophe That Never Happened*](#) and, coming in late 2021 or early 2022, *Fallen Icon: David Attenborough and the Walrus Deception*.



I have also written two science-based novels about polar bears that adults and older teens will enjoy: [*EATEN*](#) (a polar bear attack thriller set in Newfoundland, Canada) and [*UPHEAVAL*](#) (about a sea ice tsunami, set in Cape Breton Island, Canada – with a polar bear twist).

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Introduction

Many school systems in North America (and perhaps elsewhere) include a unit or module on Arctic ecology and conservation in middle-school. Depending on the district, this is usually Grades 6-8 for children aged 11-13. Some schools include this topic for advanced 10 year olds in Grade 5.

In 2015, I gave a dozen or so presentations on polar bears to middle school classes in my home town of Victoria, British Columbia (Canada). I developed the student-level presentation at the request of a few dedicated teachers who discovered that I offered an adult version through the university's Speakers Bureau entitled *Polar Bears: Outstanding Survivors of Climate Change*. I had a great deal of fun doing this and learned a lot from the kids in the process: their attentiveness and lack of fidgeting told me the material was age-appropriate and engaging, while the kinds of questions they asked told me the concerns that were most on their minds.

The most pertinent fact about polar bear conservation that people need to know is that it was the first species *ever* to be declared 'vulnerable to extinction' (also known as 'threatened') based on predictions of what might happen in the future rather than existing conditions. This means that the conservation term 'vulnerable' is identically applied to the common hippopotamus – which has suffered a major decline in numbers over the last 30 years and currently lives in a fraction of its former range – as well as to the polar bear, which has had an increasing population over the last 30 years and currently lives throughout its entire traditional range.

This confusing language meant that every teacher and student I asked estimated the current global population size for the polar bear as 'several hundred' or perhaps 'two or three thousand' (as would be true for the common hippo), while the actual official estimate provided by the International Union for the Conservation of Nature (IUCN) at the time was 26,000 (with a probable range of 22,000-31,000). They were all astonished at this information and eager to understand why they had been so misinformed. I told them what I have just told you. Then I reminded them that predictions about the future are not scientific facts but opinions and I was there to talk to them about scientific facts. Facts come from discovering what has happened in the past and what has been happening

recently. All talk about the future of polar bears is conjecture based on assumptions that may or may not be true: interesting perhaps, but not scientific fact. Computer model simulations are not scientific experiments and the results are not ‘proof’ of anything. I am of the opinion that if children are deemed old enough to learn about Arctic ecology and conservation issues (which can be rather complex concepts even for adults) they are old enough to be taught the difference between fact and conjecture.

After my in-class experiences, I saw a need for a reference book for kids of that age group that provided the facts they needed and wanted to know without the alarming message of future extinction and deaths by starvation they seemed to be getting everywhere – from news reports, documentaries, nature programs, cartoons, and even school textbooks and online resources. In 2016, I published *Polar Bear Facts & Myths* and it has been very popular. You’ll find more details on the book elsewhere in this guide.

This year, I published another book for middle-school-aged kids called *Walrus Facts & Myths*. With many more parents choosing to homeschool their children, it occurred to me that these two Arctic-themed *Facts & Myths* books might be very useful for parents attempting to provide a balanced and scientifically truthful ‘Arctic Sea Ice Ecology’ module to their middle school-aged kids, in addition to, or instead of, what their local school district provides. However, to get the full benefit, many parents might find it useful to have a short teaching guide to augment the books.

You’ll find plenty of free online ‘help’ for teachers on the topic of Arctic ecology from conservation organizations like World Wildlife Fund, National Geographic, Sierra Club, and Polar Bears International. These are worth checking out. But keep in mind that while much of the information is indeed correct and useful, the material is also filled with misleading or inaccurate information that comes from treating assumptions and conjectures about the possible future facing Arctic species, and even the entire Arctic ecosystem, as if they were facts. This approach has been shown to cause children anxiety, with some more affected than others. Swedish climate change activist Greta Thunberg, for example, has said her anxieties about the world that caused her to stop eating at age 11 came a few years after [she saw a documentary about starving polar bears](#) at school. I think most children of middle-school age [can do without that particular stress](#).

There is no need to give children nightmares about starving polar bears and dying walrus in order to teach them the science about how life works for animals that depend on Arctic sea ice to survive. In this short guide, I'll show you how.

Using my two *Facts & Myths* books (both available in paperback and ebook formats) as a foundation, I've put together some useful graphics and searched the internet for appropriate videos and other background resources that don't contain gloomy climate change messaging or where it is minimal or low key. I've done this so that you don't have to try and assess everything you come across. For example, some older [National Film Board of Canada](#) videos are excellent and still relevant. I have kept in mind that siblings of the intended students might be watching some of these films and give you a heads-up where material might be upsetting or simply boring for younger children. I've also devised a simple game the kids might find fun to play, which would be easy (with some online research) for older students to augment.

Some of the concepts touched on in this guide include: ecosystems, food chains, habitats, sea ice, water depth (bathymetry), seasonal habitat changes, geological climate change (natural change over time).

I can always be reached via the 'Contact me' page on my [PolarBearScience](#) blog if you have questions, suggestions, or would like copies of additional reference material. My goal is to help you and your children learn about an exciting topic.

I have decided to make this guide available for free, with the understanding that the purchase of my *Facts and Myths* books might be all that some households can afford. However, the compilation of this guide did take considerable time and effort, so if it is within your means please make a small donation via the home page of my blog at [PolarBearScience](#) (top right-hand corner).

A suggested donation amount is \$6.00.

Resources Provided

Section 1. List of Arctic species books

Section 2. Suggested activities

Section 3. Online resources for additional information

Section 4. Recommended videos (annotated summaries)

Section 5. Glossary of terms

Section 6. Sea ice facts

Section 7. Arctic species facts

Section 8. The Arctic food chain

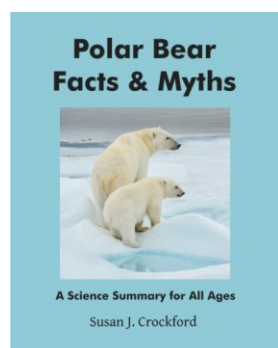
Section 9. Arctic sea ice ‘what am I?’ flash cards

Section 1. List of Arctic Species Books (by the author)

These three books highlight the facts about the top two Arctic species that children need and want to know about without frightening them with dire warnings about predicted future extinctions.

Polar Bear Facts & Myths (2016; age 7 and up), in paperback and ebook formats.

Translations available in [French](#), [German](#), [Dutch](#), [Norwegian](#), [Portuguese](#) (paperback only).



This beautiful, full color summary explains in simple terms why polar bears are thriving despite the recent loss of Arctic sea ice. It's written in a question and answer format, in language that readers of all ages can understand (age 7 and up). The book takes a sensible, big-picture approach to Arctic ecology that readers will appreciate and is based on the most up-to-date information available. The translations are especially useful for English-speaking students learning a new language as well as for those whose first language is not English.

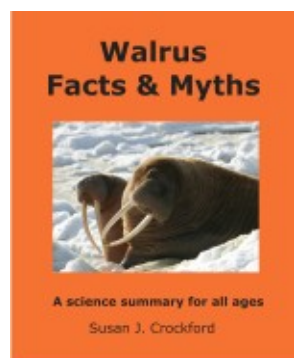
Amazon US and International <https://www.amazon.com/dp/1541123336/>

Amazon Canada <https://www.amazon.ca/Polar-Bear-Facts-Myths-Science/dp/1541123336>

Amazon UK <https://www.amazon.co.uk/dp/1541123336>

Smashwords link <https://www.smashwords.com/books/view/693175> [has as a pdf option]

Walrus Facts & Myths (2021; age 7 and up), in paperback and ebook formats.



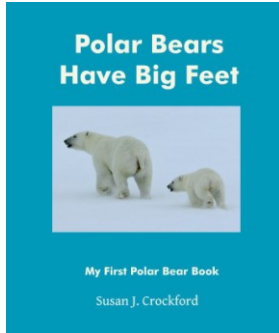
This beautiful, full color summary explains current walrus ecology and conservation status in language that readers of all ages can understand (age 7 and up). Walrus are thriving despite the recent loss of Arctic sea ice because they have been able to adapt to those changes. This science book is written in a question and answer format based on the most up-to-date information available. This sensible, big-picture approach is one all readers are sure to appreciate and a great aide for homeschoolers learning about Arctic ecology.

Amazon US and International <https://www.amazon.com/Walrus-Facts-Myths-science-summary/dp/0991796667>

Amazon Canada <https://www.amazon.ca/Walrus-Facts-Myths-science-summary/dp/0991796667>

Amazon UK <https://www.amazon.co.uk/Walrus-Facts-Myths-science-summary-ebook/dp/B09DT9XHLQ>

Polar Bears Have Big Feet (2017; age 3-6), paperback only.



This beautiful color book is a 'first science book' for preschoolers who love polar bears. There are no gory images, no discussion of starving bears, climate change, or threatened species - just fabulous pictures of polar bears doing what they do in their natural Arctic habitat, accompanied by lighthearted descriptions. It's a great first polar bear science book for adults to read to kids but it's also one that kids will want to learn to read. This is a useful companion book for younger siblings of middle school children who are studying the Arctic Sea Ice Ecosystem.

Amazon US and International <https://www.amazon.com/dp/1541281829/>

Amazon Canada <https://www.amazon.ca/dp/1541281829>

Amazon UK <https://www.amazon.co.uk/dp/1541281829>

2. Suggested activities

It's useful to have some activities to ensure children process and retain the information they have learned. Here are a few suggestions to get you started (choose the ones that best fit your child's age and abilities):

1. Make bingo cards for the Arctic sea ice habitat and play while watching one of the ecosystem videos from section 4 (especially *Life on Ice* or *Edge of Ice*). Use these words, in different orders on each card (the centre square is usually a 'free' space):

ringed seal, polar bear, bearded seal, ivory gull, krill, plankton, Arctic fox, beluga, narwhal, entrapment, hunter, scavenger, Arctic cod, Polar cod, algae, new ice, polynya, bowhead whale, Inuit, fat, cold, dark, nest, eggs

Here are two bingo card templates <https://freeology.com/fun/blank-bingo-cards-template/>
<https://www.sampletemplates.com/business-templates/blank-bingo-template.html> [Word]

2. Make a diorama of a piece of Arctic sea ice and include as many creatures as you can. Draw or cut out the animal pictures.

3. Write a story about a polar bear walking on the sea ice and all the other animals it sees along the way, or tell the story of an ivory gull as it searches the sea ice for food.

4. Draw the Arctic food chain, perhaps using a combination of cutout pictures and markers or paints.

5. Make a list of Arctic animals from largest to smallest: e.g. bowhead whale, beluga, walrus, polar bear, bearded seal, ringed seal, ivory gull, Arctic cod, krill.

5. Draw a polynya with all of the creatures that live there.

6. Guess "Who am I" from a set of clues on flash cards (Section 9); I've given five or six clues for younger children but you can make it harder for older kids by only giving them two or three clues.

7. Fill the work table below with the creatures that live in the Arctic sea ice ecosystem year round (*residents*) and those that are only summer visitors.

Arctic sea ice ecosystem table

This table is simple for younger children although older ones can add to it by doing their own research. For example, harp, ribbon, spotted, and hooded seals are also sea ice residents but only live in some parts of the Arctic, which is also true for the Greenland shark. Sea ice *residents* are Arctic species that live on or under the ice year round, while summer *visitors* are animals found only during the summer.

Arctic Sea Ice Species Table (example)

	Mammals	Birds	Fish	Bottom feeders	Floaters
Residents	Polar bear	Ivory gull	Polar cod	Clams	Phytoplankton
	Walrus		Arctic cod	Crabs	Zooplankton
	Narwhal				Krill
	Beluga				
	Bowhead whale				
	Ringed seal				
	Bearded seal				
	Arctic fox				
Summer Visitors	Killer whale	Arctic tern	Salmon		
	Grey whale	Common eider			
	Humpback whale	Snow goose			
		Kittywake			

List the creatures of the Arctic sea ice ecosystem:

[illegible]

3. Online resources for additional information

North Atlantic Marine Mammal Commission (NAMMC)

<https://nammco.no/marinemammals/>

Norwegian Polar Institute

<https://www.npolar.no/en/species-archive/>

NOAA Fisheries

<https://www.fisheries.noaa.gov/species-directory>

Active Wild

<https://www.activewild.com/arctic-animals-list/>

All About Birds

<https://www.allaboutbirds.org/guide/>

National Film Board of Canada documentaries

<https://www.nfb.ca/documentary/> [search by topic in the left sidebar]

National Snow and Ice Data Center, MASIE ice charts (daily)

<https://nsidc.org/data/masie/>

National Snow and Ice Data Center, Arctic sea ice news (monthly reports and seasonal maximum/minimum reports)

<http://nsidc.org/arcticseaicenews/>

Canadian Ice Service (daily ice charts)

<https://www.canada.ca/en/environment-climate-change/services/ice-forecasts-observations/latest-conditions.html>

IUCN Canid Specialist Group

<https://www.canids.org/species/view/PREKKS663901>

Government of Canada Maps of subpopulations of polar bears and protected areas

<https://www.canada.ca/en/environment-climate-change/services/biodiversity/maps-subpopulations-polar-bears-protected.html>

Section 4. Videos about Arctic sea ice habitat and ecology

1. Life on Ice 1986 27 min; Colour; Free streaming; ****Excellent

https://www.nfb.ca/film/life_on_ice/

Suitable for all ages although youngest viewers may sometimes be bored; Shows Arctic ecology fall through summer; discusses ice formation in fall and breakup in summer; shows under-ice life; discusses ice-entrapment of belugas and shows bears killing seals which might be distressing to some unless you prepare them for it; discusses polynya (open water in winter) formation; algae, krill, narwhals, polar bears, sea birds, seals, whales and walrus.

2. The Face of the High Arctic 1958 12 min; Colour; Free streaming; ***Good

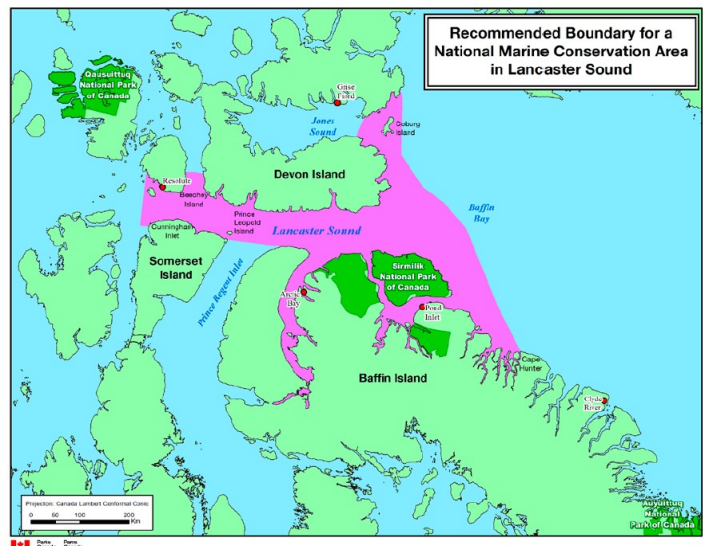
https://www.nfb.ca/film/face_of_the_high_arctic/

Youngest viewers will probably be bored with lack of action; good short introduction to the High Arctic climate and concept of Ice Ages; discussion of geological climate change and geographic processes; discusses less glacier ice and sea ice breakup; origin of glaciers and icebergs; mentions former warm times based on fossil evidence.

3. Edge of Ice 1986 55 min; Colour; Free Streaming; ***Excellent

https://www.nfb.ca/film/edge_of_ice/

This is an excellent presentation on Arctic sea ice and the food chain filmed in Lancaster Sound, Canada. Narrated in parts by an Inuit hunter, shows polar bears, ringed seals, narwhals, beluga, bowhead whales, walrus, bearded seal, ivory gull, Arctic tern, Sabine's gull, thick-billed murres, process of freezing and thawing; life under the ice and the importance of polynyas. There are two hunting scenes which you can forward past but the film tastefully presents hunting as a vital part of Inuit and Arctic life, so older children might find it of interest (one at 23:25-28:25, butchering of a narwhal (but not the kill); and killing of a ringed seal at 34:10-35:30, butchered at 38:34 with a good discussion of the importance of fat). There are great photos of under-ice algae and phytoplankton, Arctic and polar cod; ringed seals swimming under water. NOTE an error: walrus don't dig for food with their tusks.



Videos about polar bears

1. Hinterland Who's Who: The Polar Bear 1973 1:00 min. Free streaming; ***Good

Very short and suitable for all ages; shows adult bears swimming and hunting; shows cubs just out of the den near Churchill, Manitoba (on Hudson Bay)

<https://www.nfb.ca/film/hinterland-whos-who-the-polar-bear/>

2. Three polar bears swimming, diving and playing on new ice; 1:28 min. ***Good

Filmed in the Chukchi Sea near the town of Ryrkaypiy in Chukotka in November 2019; no narration, suitable for young children

<https://www.youtube.com/watch?v=TorVfG-92rE>

3. Mother polar bear and her litter of triplets leave birthing den; 2:13 min. ***Good

Filmed in Western Hudson Bay, narrated, suitable for young children

<https://www.youtube.com/watch?v=Xzj8H0y-a9M>

4. BBC Earth 2020; narration OK; 2:36 min. *** Good

Polar bear stalks a bearded seal; he doesn't get it but it's interesting to watch it try; suitable for young children if you prepare them; can also watch with the sound off.

<https://www.youtube.com/watch?v=F9YeBUIsDu0>

5. Adult polar bear walking on ice during the summer; 1:20 min. ** Not bad

No narration, suitable for young children but might be a bit boring for them

<https://www.youtube.com/watch?v=1CJbl0IBLIU>

6. Best Polar Bear Moments | Part 1 | BBC Earth 17 Dec 2020; 16:40 ** Not bad

A few bits of misleading and/or inaccurate information but otherwise good photography of the lives of polar bears; might not be suitable for younger children because of the hunting scenes unless you prepare them for it

<https://www.youtube.com/watch?v=nFsdaYuIJCUI>

Includes filming polar bears and the danger of getting too close; skinny polar bear hunting a bearded seal; bears feeding at bowhead whale carcass in Alaska; a bear hunting walrus.

7. Best Polar Bear Moments | Part 2 | BBC Earth 24 Dec 2020; 13:51 ** Not bad

A few alarmist comments and bits of misleading and/or inaccurate information but otherwise good photography of the life of polar bears; might not be suitable for younger children unless you prepare them for it because of the hunting scenes

https://www.youtube.com/watch?v=7gga4Z_d4U

Curious polar bear destroys a camera (very good); mother and cubs; several bears hunting walrus [note the on-screen title erroneously calls them 'sea lions']

8. The Wild Canadian Year: Summer 2018; starts at 36:50; ** Not bad

Adult polar bear hunting beluga whale; may be disturbing for young children unless you prepare them for it.

https://www.youtube.com/watch?v=C-kDbS_-OBo&feature=youtu.be

9. BBC Earth 2020; 3:16 minutes; ** Not bad if you watch with sound off

Fat polar bears feeding on a whale carcass at Kaktovik, Alaska; also shows mother and cubs swimming

<https://www.youtube.com/watch?v=wEFwPy5XclA>

Videos about other species

Note that both 'walrus' and 'walruses' are grammatically correct for referring to more than one animals. I stick to 'walrus' but others don't.

1. Walruses in the Arctic 15 Nov 2018 1:34 minutes ***Good

Short but informative summary

<https://www.youtube.com/watch?v=pQ2xVYtf4Ik>

2. Walrus Mom and Baby Cuddle | National Geographic 7 May 2009 2:47 minutes ***Good

Footage of a cow and newborn calf only a few hours old on the ice in spring

<https://www.youtube.com/watch?v=IJGclHmsps>

3. Walrus Calf Falls Off Rock. WWF, 13 January 2015. 2:00 minutes ***Good

A young walrus climbs up a rocky point to reach its mother; no one gets hurt but shows how well walrus can climb

<https://www.youtube.com/watch?v=PAegOrGiDnA>

4. Walrus Fights for Space to Sleep Explore Oceans, May 2015 1:00 ** Not bad

No actual fighting: it shows adult males in the summer at Round Island in the Bering Sea wriggling around trying to get comfortable

<https://www.youtube.com/watch?v=T8jujZQfq7E>

5. Facts: The Bowhead Whale Deep Marine Scenes, 2020 2:52 ****Excellent

Suitable for all ages, with subtitles; focus on biology and ecology, mentions 'climate change' as one of several potential risks for future survival at the very end but not in detail.

<https://www.youtube.com/watch?v=aAMoZbKTPQ>

[Note other bowhead videos I've come across either include scenes of hunting whales or are actually focused on this activity, which many children could find upsetting]

6. Facts: The Beluga Whale Deep Marine Scenes 2016 2:44 ****Excellent

Suitable for all ages, with subtitles; focus on biology and ecology

<https://www.youtube.com/watch?v=L14bl7GwHK8>

7. See Hundreds of Beluga Whales Gathering 2017 National Geographic Wild 0:59 ***Good

Suitable for all ages; up to 800 beluga whales in Lancaster Sound, Canada; Music only.

<https://www.youtube.com/watch?v=wyvLDDnHBwA>

8. Narwhals The Unicorns of the Sea! 2018 National Geographic Wild; 2:36 ***Good

<https://www.youtube.com/watch?v=MXsZg1sQYvA>

9. Narwhals World's Weirdest, 2012 National Geographic Wild; 2:09 ***Good

<https://www.youtube.com/watch?v=YO58kt-jETA>

10. Narwhals Clip from *Our Planet*, 2019 Netflix; 2:54 ***Good

Suitable for all ages, Attenborough narrated.

<https://www.youtube.com/watch?v=UVwYygnGkPE>

11. Hooded Seal | World's Weirdest National Geographic Wild Sept 2012 1:59 ** Not bad

Male seals shown blowing up their 'balloon' (the 'hood'); suitable for all ages

<https://www.youtube.com/watch?v=ZPFkmwo8DQU>

12. Hinterland Who's Who: The Greater Snow Goose 1978; 1 min; colour; ***Good

https://www.nfb.ca/film/hinterland_whos_who_greater_snow_goose/

Videos about general Arctic ecology (related topic)

1. Islands of the Frozen Sea 1958 29 min; Black & White; Free streaming; ***Good

Mostly about life on land in the Arctic; good for older children, young viewers might be bored with lack of colour, action, and archaic language from explorers quoted but there is lots of images of snow and pack ice; NO polar bears or walrus but you see musk ox, lemmings, migratory nesting birds, snowy owl, snow goose, Arctic loon, Arctic hare, Arctic wolf and sea creatures (plankton, krill); good description of seasonal change to summer abundance; history; geology; fossils; perhaps a chance to talk about early explores [and how their impressions were coloured by their own knowledge and biases]

https://www.nfb.ca/film/islands_of_the_frozen_sea/

This short documentary offers a look at the life forms on the Queen Elizabeth Islands within the Arctic Circle. Even in this frigid zone of icebergs and glaciers a surprising variety of wildlife and vegetation is seen. Writings from the logbooks of early explorers provide vivid descriptions of scenes as arresting to them in their century as to today's explorer.

2. High Arctic: Life on the Land 1958 21 min Black & White; Free streaming ***Good

All about life on land in the Arctic (a shorter version of #1); good for older children, young viewers might be bored with lack of action and colour; good description of seasonal change to summer abundance.

https://www.nfb.ca/film/high_arctic_life_on_the_land/

An ecological study of plant and animal life on the Queen Elizabeth Islands in the Canadian Arctic. The film includes profiles of animals such as musk-oxen, lemmings, arctic hares and various forms of plant life.

Videos about Inuit life in the Arctic (related topic)

1. How to Build an Igloo 1949 10 min Free streaming; Colour **** Excellent

Suitable for all ages

https://www.nfb.ca/film/how_to_build_an_igloo/

2. Tuktu and his Eskimo Dogs 1967 14 min; Colour; Free streaming ****Excellent

Translated narration of an old Inuit man about his life as a young boy; lots of images of children in traditional dress; might not be suitable for younger children because it includes scenes of the killing and butchering of a seal that might be distressing unless you prepare them for it.

https://www.nfb.ca/film/tuktu_eskimo_dogs/

This short docu-fiction film illustrates how traditionally dogs were used by the Netsilik Inuit, in winter and summer. We see puppies and sled dogs used as pack animals. Eskimo dogs were also used for hunting, being particularly skilful at sniffing out seal blowholes when deep snow covered the winter sea ice.

3. An Inuit/Eskimo family in the Arctic 1959 16:17 Colour *** Good short summary

Includes a seal hunting scene which younger children might be upset by unless you prepare them for it; ERROR, note the statement that Eskimo dogs are part wolf is not correct

<https://www.youtube.com/watch?v=uB4JGUzve6M>

The barren life of an Inuit family and their children in Iqaluit, Nunavut [Baffin Island], Arctic Canada more than fifty years ago.

4. Land of the Long Day 1952 37 min Free streaming; Colour *** Good

Younger children might be bored and/or upset by the hunting scenes unless you prepare them for it.

https://www.nfb.ca/film/land_of_the_long_day/

This short documentary journeys to Baffin Island. For four months in the summer, the Arctic has continuous daylight. During this time, provisions must be made for the long dark winter ahead. Idlout, an Inuit hunter, recounts his experiences living in this northern land, where he hunts seal, walrus, whales and polar bears, among other animals. His wife, children and elderly parents each have their own work to do in their unending struggle to survive in this harsh land.

5. At the Spring Sea Ice Camp: Part 1 1967 26 min; Colour; Free streaming; *** Good

This series 'At theCamp' [more below] is suitable for older children who are interested in seeing more detail; native language, traditional dress; traditional activities including hunting. Note the Netsilik Inuit live in the [central Canadian Arctic](#) around the town of [Cambridge Bay](#).



https://www.nfb.ca/film/at_the_spring_sea_ice_camp_part_1/

In this short documentary on the Netsilik Inuit, Inuit families travel across the sea ice. Before night falls, they build igloos. A boy practices throwing his spear at a figure he has made in the snow. A woman crimps the sole of a sealskin boot she is making.

6. At the Spring Sea Ice Camp: Part 2 1967 26 min; Colour; Free streaming; *** Good

Suitable for older children; native language, traditional dress; traditional activities

https://www.nfb.ca/film/at_the_spring_sea_ice_camp_part_2/

In this short documentary on the Netsilik Inuit, men hunt seal through the sea ice. A hunter strikes, and takes his catch home to skin. A polar bear skin is pegged out to dry, and people nibble on raw fish from the cache.

7. At the Spring Sea Ice Camp: Part 3 1967 26 min Colour; Free streaming; *** Good

Suitable for older children; native language, traditional dress; traditional activities

https://www.nfb.ca/film/at_the_spring_sea_ice_camp_part_3/

In this short documentary on the Netsilik Inuit, a hunter, travelling alone with sled and dogs, snares and kills a squirrel. In camp, a sled is made from a polar bear skin. The family breaks camp, and moves ashore for the summer.

8. At the Winter Sea Ice Camp: Part 1 1967 35 min; Colour; Free streaming; *** Good

Suitable for older children; native language, traditional dress; traditional activities

https://www.nfb.ca/film/at_winter_sea_ice_camp_pt_1/

In this short documentary on the Netsilik Inuit, an Inuit family stop their trek and make camp. It is late winter when the cold is severe. The men cut blocks for an igloo while the women shovel the site. During the day, the men sit patiently on the ice, waiting for seals.

9. At the Winter Sea Ice Camp: Part 4 1967 34 min; Colour; Free streaming; *** Good

Suitable for older children; native language, traditional dress; traditional activities

https://www.nfb.ca/film/at_winter_sea_ice_camp_pt_4/

This short documentary on the Netsilik Inuit shows the life of the community inside the igloo. A stone chip is removed from a woman's eye. Men and women gamble at spear-the-peg game. The day ends with a drum performance. The next day the big igloo is deserted and the Inuit are again trekking over the broad expanse of sea ice.

Videos to definitely avoid

1. BBC's *Hostile Planet* polar bear sequence

<https://www.youtube.com/watch?v=edHWwHE0kVA&feature=youtu.be>

The polar bear sequence from the 'Hostile Planet' series released for distribution to the media on Youtube is both alarmist and contains misleading and/or inaccurate information

2. *Lords of the Arctic* 2003 National Film Board| 52 min Colour; Limited access

https://www.nfb.ca/film/lords_of_the_arctic/

Both alarmist and contains misleading and/or inaccurate information

This documentary by award-winning filmmaker Caroline Underwood focuses on Northern wildlife and its close and tragic relation to climate change, which affects all of the Arctic's fragile ecosystems. The example of the polar bear, studied by biologists for the past 20 years, is revealing. Scientists are also concerned about the precarious situation of bowhead whales and belugas, not to mention seals, walrus and many species of birds. Are the lords of the Arctic in danger of ending their reign over their kingdom of ice and snow?

Section 5. Glossary of terms used here or in videos or other material

IUCN – International Union for the Conservation of Nature [the largest conservation organization in the world, which publishes the *Red List of Threatened and Endangered Species*]

USGS – United States (of America) Geological Survey [a federal government department]

USFWS – United States (of America) Fish & Wildlife Service [a federal government department]

NSIDC – US National Snow and Ice Data Center [a federal government department]

DFO – Department of Fisheries and Oceans Canada [a federal government department]

Pleistocene – the last geological age (about 2.6 million – 11,500/11,700 years before present)

Present – in carbon dating, refers to a standard reference time of 1950.

Glacial – thousands of years of intensely cold climate when polar and mountain glacier ice expanded

Interglacial – thousands of years of globally warm climate between glacial periods.

LGM - Last Glacial Maximum, aka Last Ice Age (26,000-11,500/11,700 years before present)

Holocene – the latest stage of the Quaternary, which began about 11,500/11,700 years before present

Quaternary Period – Pleistocene plus the Holocene

Holocene Climate Maximum – a long warm period from 11, 500/11,700-8,500 years before present.

Eemian – aka Sangamonian, last warm Interglacial (about 130,000-110,000 years before present)

SAMBR – State of the Arctic Marine Biodiversity [Report](#)

North Water polynya – a very large polynya found between northwest Greenland and Ellesmere Island

Perennial sea ice – ice that does not melt completely in winter

Multiyear ice – see ‘perennial’ ice, refers to ice (by number of years old) that survived the last summer

Annual ice – also known as first year ice, refers to ice that melts completely over the summer

AWI – Alfred Wegener Institute, Germany that studies ice and oceans

GRIDA – GRID-Arendal, a [UN communications](#) organization located in Norway

Section 6: Arctic Sea Ice Facts



US Coast Guard

What and where is the Arctic?

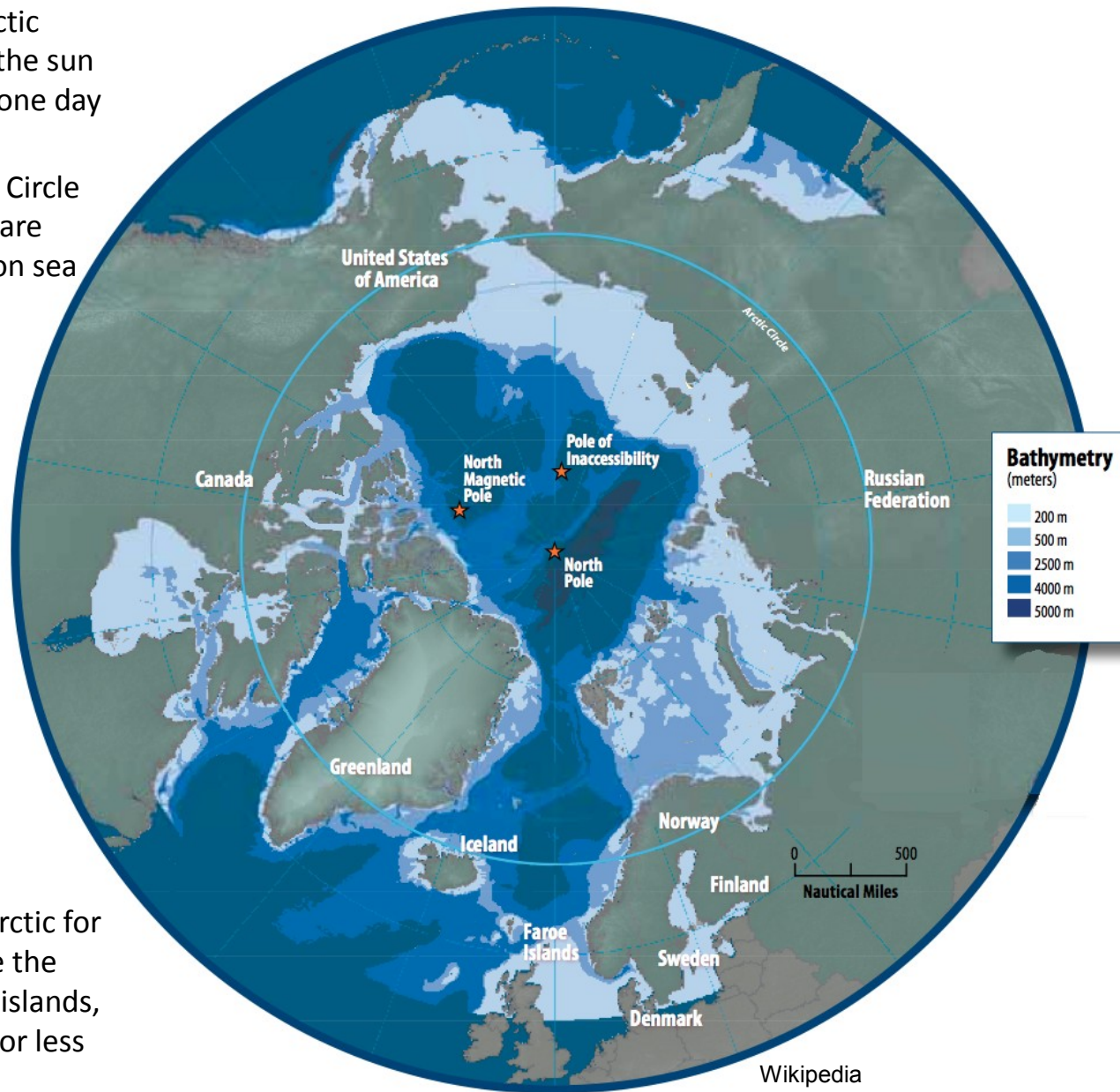
Arctic



Antarctic

Arctic ecosystems exist where there is sea ice in the winter

- Most of the Arctic is above the Arctic Circle, which is the point at which the sun shines for 24 hours in summer for one day and 0 hours for one day in winter.
- Other regions are below the Arctic Circle but still have sea ice in winter and are inhabited by species that depend on sea ice.

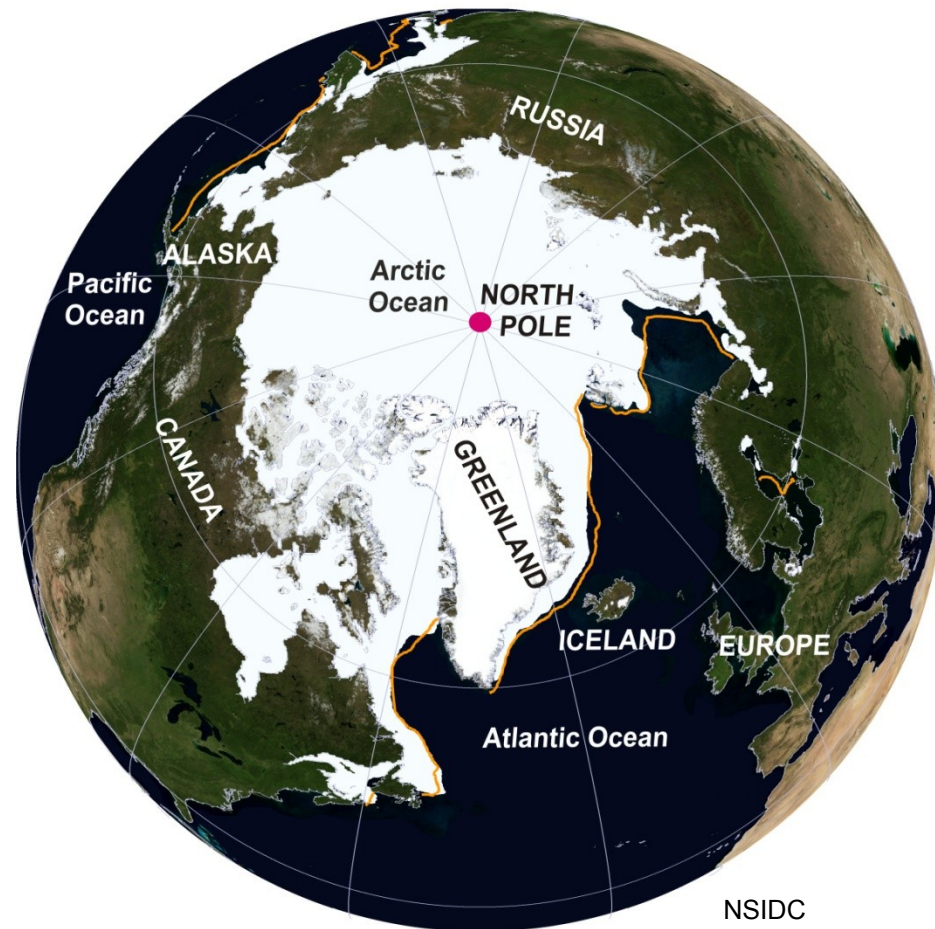


- The most important areas of the Arctic for animals that depend on sea ice are the shallow seas next to continents or islands, where the water is 200m in depth or less (light blue on the map).

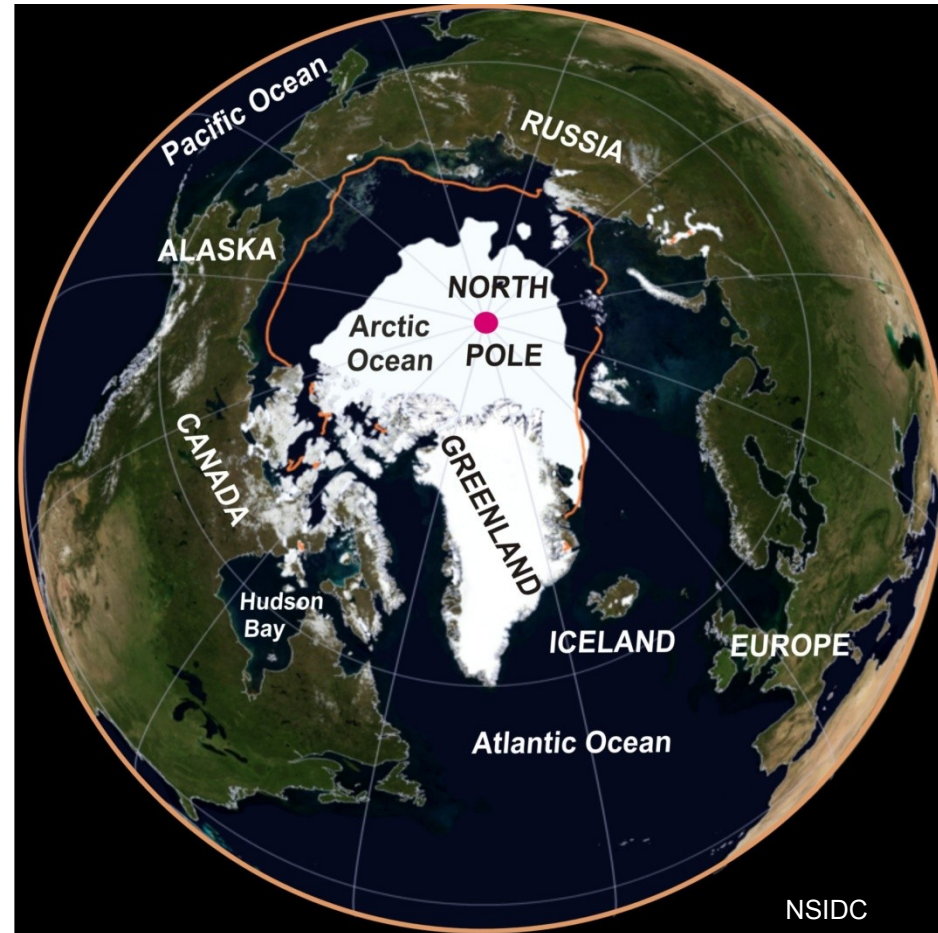
Arctic sea ice

Arctic sea ice is like water in a pond that dries up over the summer: there is a season when it is generous and spread out all over (end of winter/March) and a season of when it is skimpy (end of summer/September).

March 2016

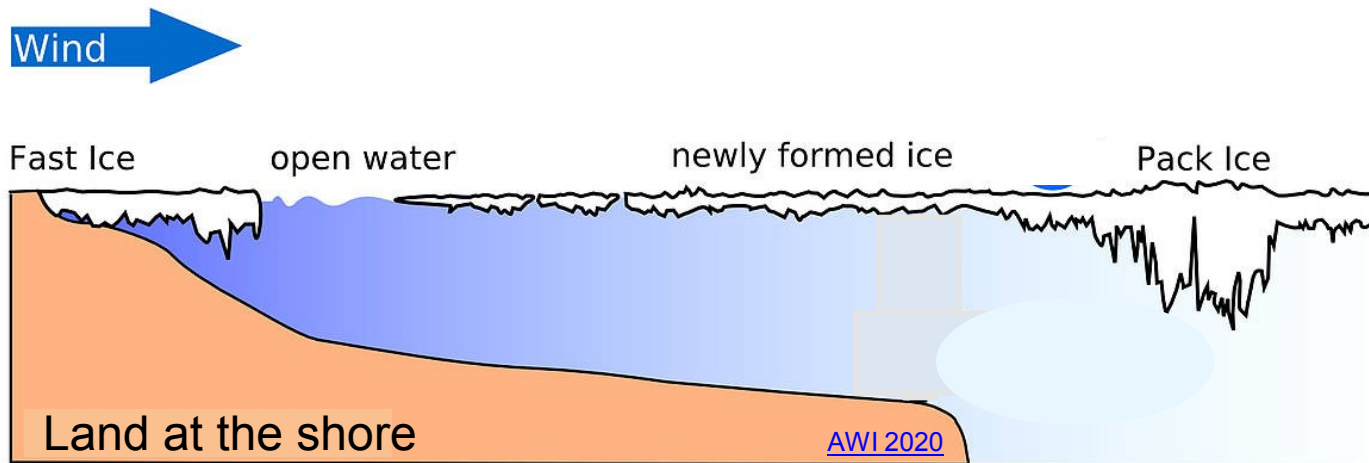


September 2012



Sea ice formation in fall

- *Fast ice* (also called *shorefast ice*) forms next to land and is attached to the shore. It does not move.
- *Pack ice* (also called *drift ice*) forms next to ice that has not melted over the previous winter. It expands the edges of the old ice until it meets the fast ice close to land. Pack ice moves with currents and is pushed by winds, which means it is *mobile* ice.



- *Leads* (also called *cracks*) are bands of open water that form between fast ice and pack ice, or that develop within pack ice as it moves around.
- *Polynyas* are patches of open water surrounded by ice that develop during the winter, spring, or early summer (depending on the area); polynyas are kept ice-free due to wind and ocean currents; the open-water lead that develops between fast ice and pack ice is one kind of polynya.

Pack ice examples



Seals next to a lead in pack ice



Harp seal and pup on 'pancake' pack ice



Polar bears on
pack ice in the
spring

A polynya is a patch of open water surrounded by ice that forms in the winter or spring

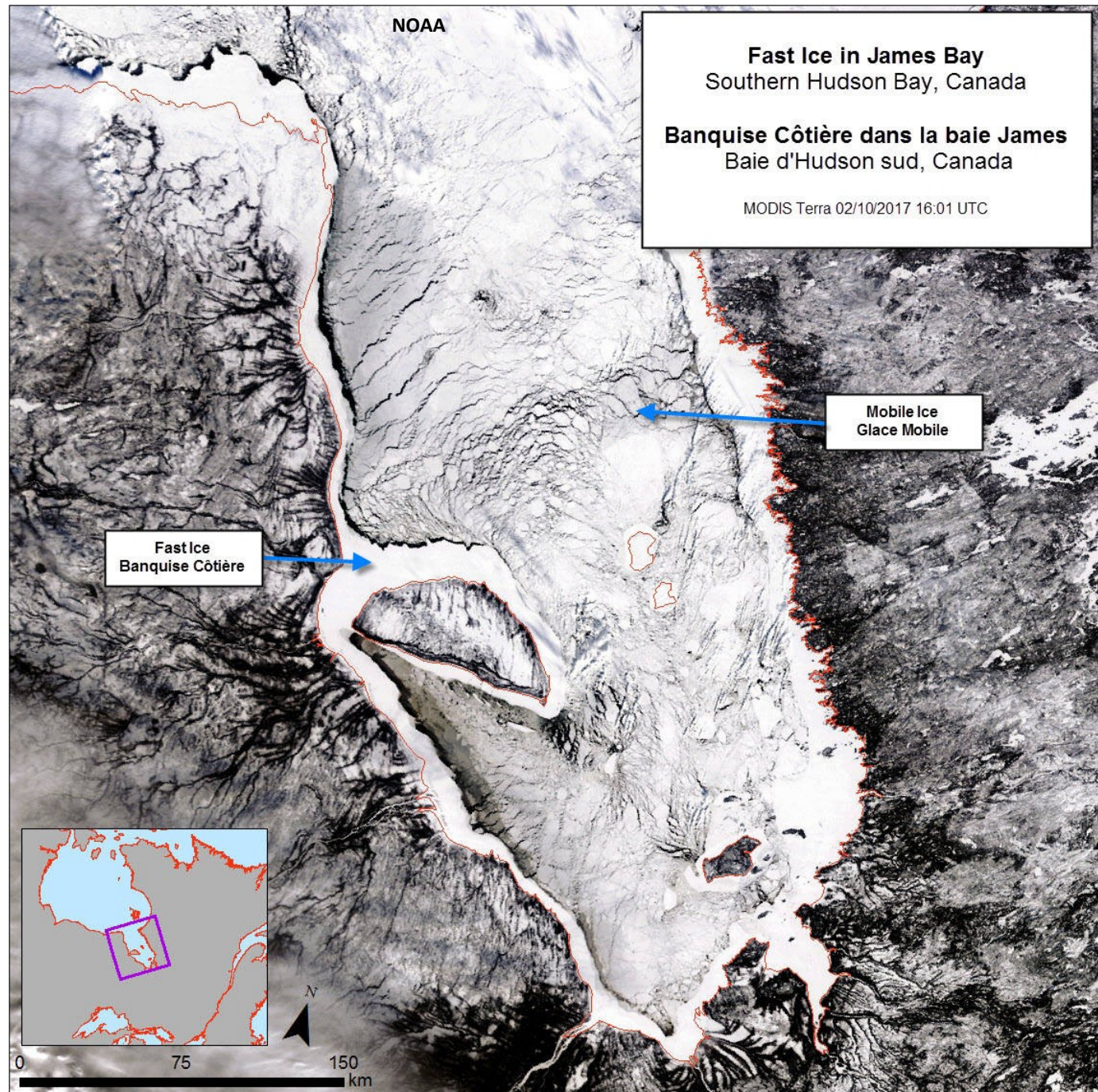


Time-lapse of the North-Water Polynya developing (on an ice chart)

<https://www.youtube.com/watch?v=D5hCA28bgOA> [2016; 26 seconds]

https://www.youtube.com/watch?v=-OmOI_SVA1A [2019; 20 seconds]

Image taken by a satellite of fast ice and mobile pack ice in James Bay, Canada: notice the many cracks (leads) in the mobile pack ice and the band of open water (lead) between the fast ice and the pack ice.



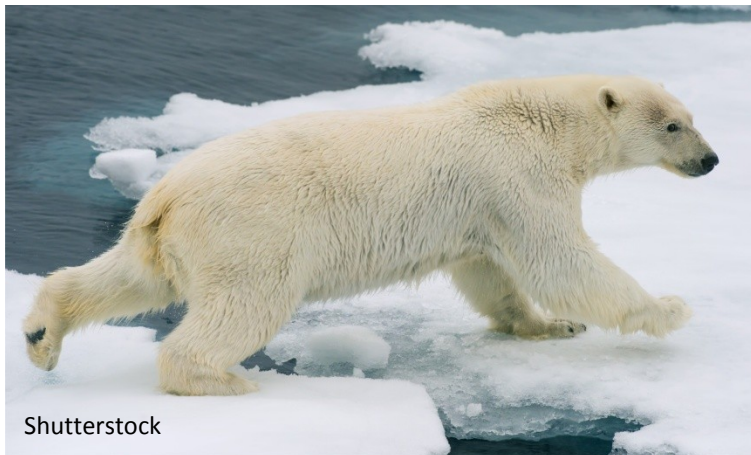
Section 7: Arctic Species Facts



NOAA

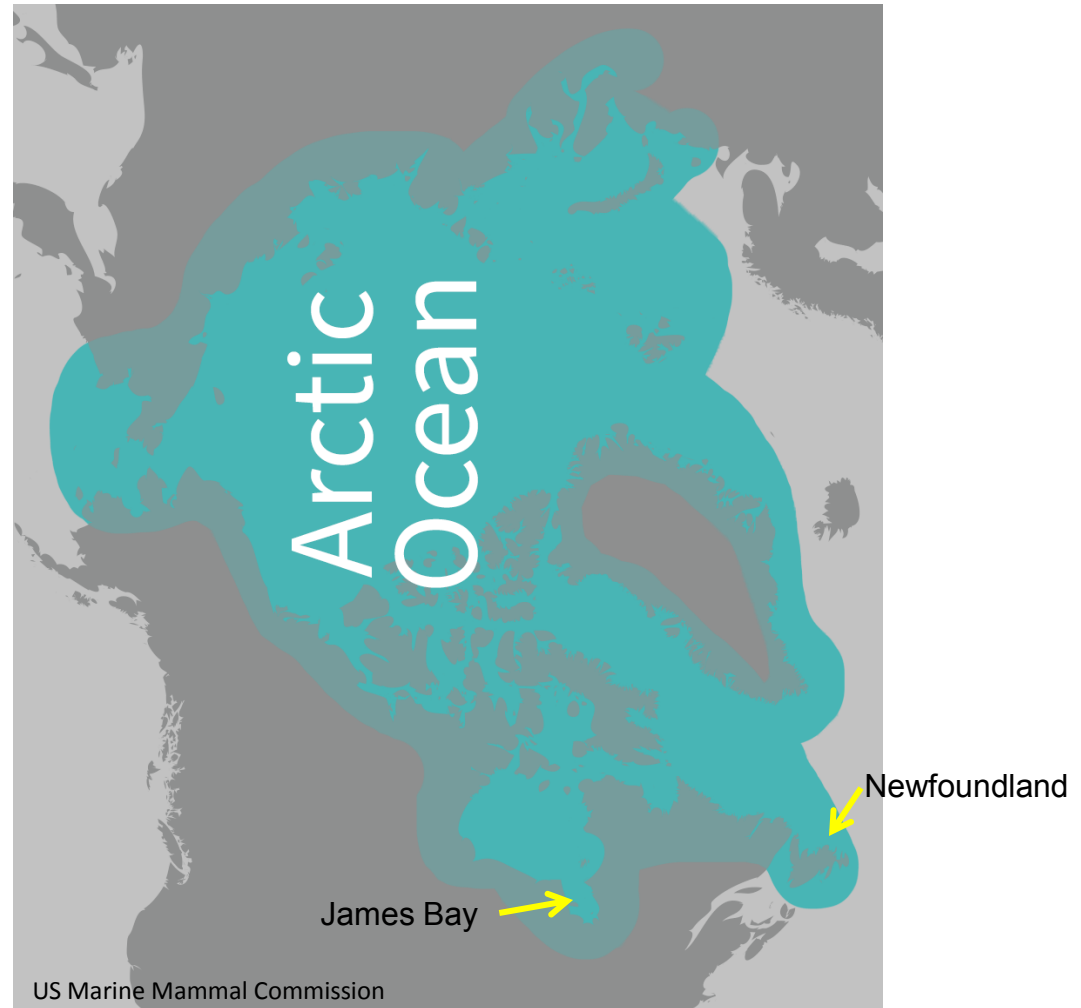
Polar bear, part 1

- Polar bears are called marine mammals because many spend their entire lives on the sea ice.
- Polar bears are excellent swimmers, good climbers, and can run very fast on land or snow.
- Polar bears have large hairy feet that are as big as a dinner plate.
- Polar bear cubs are born in late December in a snow cave (called a *den*): one to four cubs can be born, but two cubs are most common.
- All polar bears except pregnant females spend the winter on the sea ice.
- Polar bears eat ringed and bearded seals primarily but they also eat other seal species, as well as bowhead whales and walrus that have died naturally; sometimes they eat kelp or fish.
- Polar bears are carnivores (they mostly eat other animals); they hunt their prey by stalking and have no natural enemies.
- Spring is the most important feeding time for polar bears.
- Fall is the second-most important feeding time.
- Most bears *fast* over the summer or eat very little; this also happens in winter.



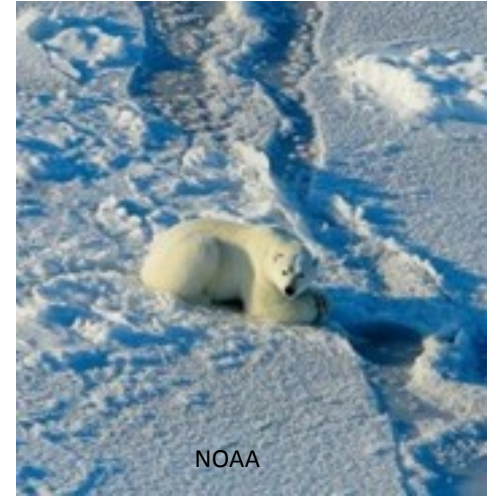
Polar bear, part 2

- Polar bears live throughout the Arctic and subarctic where there is sea ice in winter, which includes northern Newfoundland and James Bay in Canada.
- Despite concerns for the survival of polar bears due to declining summer sea ice, in 2015 the IUCN estimated the global polar bear population size was about 26,000.
- Since then, additional surveys completed up to 2020 suggest that global number may be as high as 30,000.



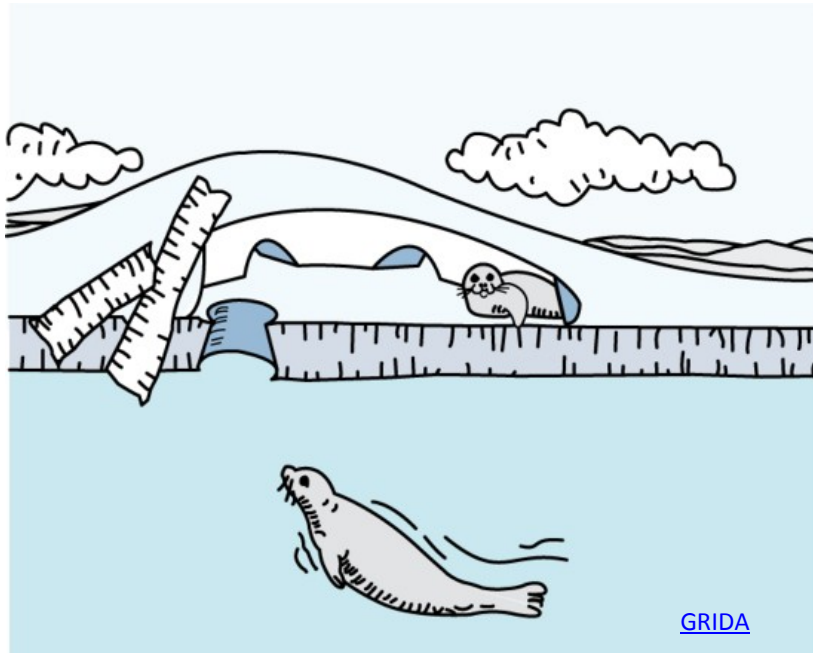
Arctic ringed seal, part 1

- Ringed seals are the smallest and most common seal found in the Arctic.
- They eat small fish and krill that live under the ice during the winter and spring but larger fish during the summer when the ice disappears.
- Ringed seals make holes in the sea ice with the claws on their front flippers and their teeth so that they can breathe. They keep these holes open all winter and spring, *and are the only seal species that does this.*
- Ringed seals have to watch out for polar bears, who sometimes lie in wait at these breathing holes hoping to catch the seal when it pops up.
- Ringed seals are the favourite food of polar bears.



Arctic ringed seal, part 2

- Pregnant ringed seal mothers hollow out a cave in the snow that covers one or two of their breathing holes in the sea ice; each female gives birth to a single small pup inside this cave (called a *lair*).
- *Ringed seals are the only seal species that does this.*
- The snow lair protects newborn pups from polar bears and foxes.
- The mother enters the lair from under the water, through one of the breathing holes in the ice, nurses the pup, and then returns to the water to eat.
- If a polar bear finds a ringed seal lair, it pounces on the cave walls with their front feet, hoping break the wall and catch the seal pup before it escapes into the water through the breathing hole.



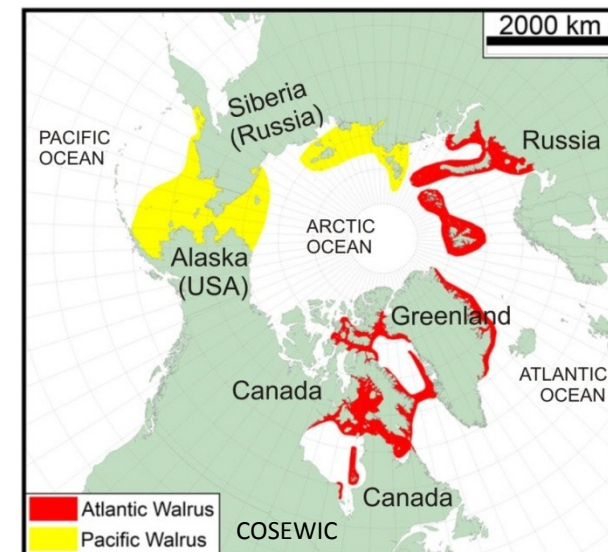
Bearded seal

- The bearded seal is one of the largest seals in the Arctic; adults are about 7-8 feet (2.1-2.4 metres) and give birth to a single large pup on the pack ice in spring; pups are about 4 feet long at birth (1.22 metres).
- Bearded seals have lots of whiskers and short, square front flippers.
- During the winter, bearded seals depend on cracks in the ice or polynyas to give them access to water so they can eat.
- Bearded seals usually eat fish and other animals like crab and sea cucumbers that they find near the bottom, so they are only found where the water under the ice is shallow.
- In the summer when ice disappears, bearded seals feed on fish in open water.
- Bearded seals are the second-favourite prey of polar bears.



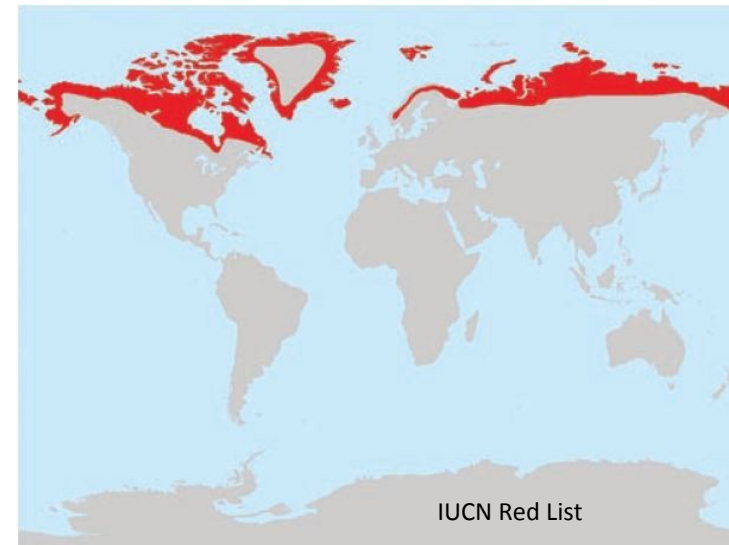
Walrus

- The walrus is a marine mammal that uses sea ice as a place to rest after feeding on the sea floor for clams, worms, and crabs.
- Both males and females have tusks, which become visible below the upper lip when a calf is about 2 years old.
- Walrus are excellent climbers on land because they can rotate their rear flippers forward to walk, just like sea lions do.
- Walrus are found where the water is shallow in the Atlantic and Pacific parts of the Arctic.
- Pregnant females give birth to a single pup on pack ice in the spring.
- Walrus often use beaches on land as a place to rest after feeding during the summer.
- Polar bears sometimes catch and eat walrus, or eat walrus that have died naturally



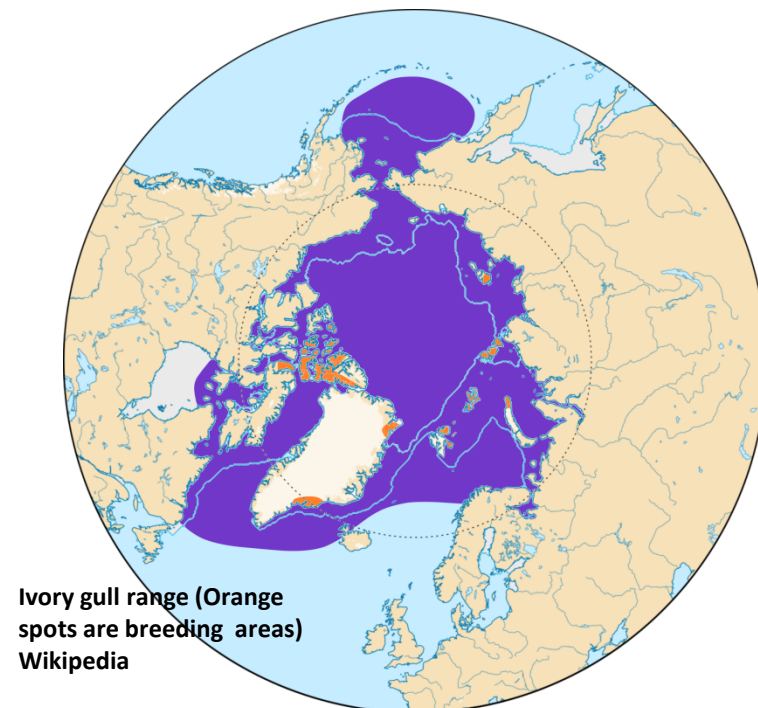
Arctic fox

- The Arctic fox is a small land mammal that often goes out on shorefast ice to kill newborn seals and eat the leftover remains of seals and small whales that polar bears have killed.
- On land, the Arctic fox eats bird eggs and newly-hatched chicks, dead fish that wash up on the beach, and lemmings and voles that live under the snow in winter all along the coast of the Arctic.
- The Arctic fox is slightly smaller than its close relative the Red fox, about as heavy as a large cat but a bit taller. Its long furry tail is about 12 inches long (30 centimetres).
- This fox is well-adapted to very cold temperatures: it has thick fur all over its body including its feet and short ears, and stores a thick layer of fat under the skin.
- Arctic foxes do not hibernate during the winter despite the frigid cold.
- The fur of the Arctic fox in most areas turns brown in the summer but is replaced by a new coat of thick white fur in the fall.
- Birth takes place on land in early summer in dens dug into the ground.
- Litters of 5 to 10 young foxes (called *kits*) are common.
- Both parents care for the young kits.
- Arctic wolves, polar bears, and even Red foxes will kill and eat Arctic foxes.



Ivory gull

- The ivory gull is a small, all-white gull with black feet and a short beak that lives in the Arctic all year round.
- It is about the size of a pigeon.
- In winter, Ivory gulls follow the edge of the pack ice or find a polynya where there is open water.
- Ivory gulls eat polar and Arctic cod, and the eggs and chicks of other birds. They also scavenge meat and fat from the carcasses of seals left behind by polar bears.



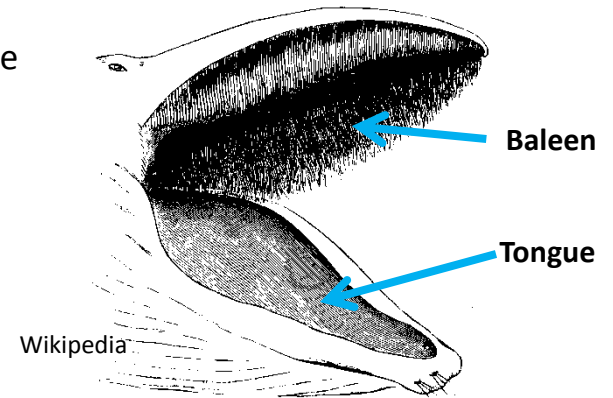
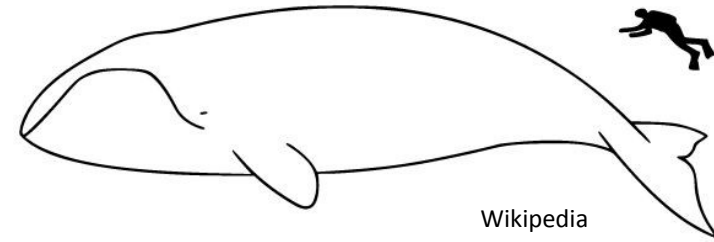
Arctic and Polar cod

- Arctic and polar cod are two similar but different species of small fish that live throughout the Arctic under sea ice most of the year.
- Both are closely related to the much larger cods we eat in fish and chips (Atlantic and Pacific cod).
- One has the Latin name *Boreogadus saida* (Polar cod) and the other is *Arctogadus glacialis* (Arctic cod) but both are commonly called *Arctic cod*, which is very confusing.
- However, the animals that eat them do not care about the name confusion: they eat either one – or both – if they can catch them!
- Arctic and polar cod are usually less than 10 inches (25.5 centimetres) in length but can sometimes reach almost 16 inches (40 centimetres).
- Both Arctic and Polar cod eat phytoplankton and the small animals (krill and zooplankton) that live under the ice.
- Arctic and polar cods are the favorite food of ivory gulls, ringed seals, beluga whales and narwhals.



Bowhead whale

- The bowhead is a large whale that grows to almost 62 feet (18.9 metres) – not quite as large as an 18-wheel transport truck.
- Bowhead whales are black with a white chin and white markings on their tail flukes.
- Bowhead whales have no teeth and no dorsal fin.
- They eat *krill*, which they catch by pushing krill-filled water against the *baleen* plates in their mouths with their thick tongues.
- Newborn bowheads are light grey and get darker as they get older.
- A very thick layer of fat, called *blubber*, keeps bowheads warm and protects them from starving when food is hard to find.



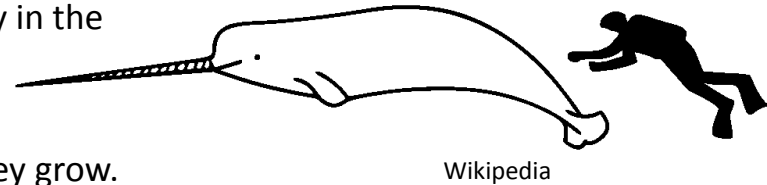
Beluga whale

- Beluga are small whales with teeth that are white all over.
- Beluga teeth are small and peg-like, for catching fish.
- The favourite foods of beluga are Arctic and polar cod.
- The skin of the beluga feels like rubber and there is no dorsal fin.
- Belugas make a lot of different sounds, which can sound to people like singing.
- Belugas often travel in large groups called *pods*.
- Belugas are protected from the cold Arctic waters by a thick layer of fat, called *blubber*.
- Belugas are born in early summer.
- Newborn belugas are dark grey and get lighter coloured as they get older.
- Beluga are eaten by killer whales and polar bears.

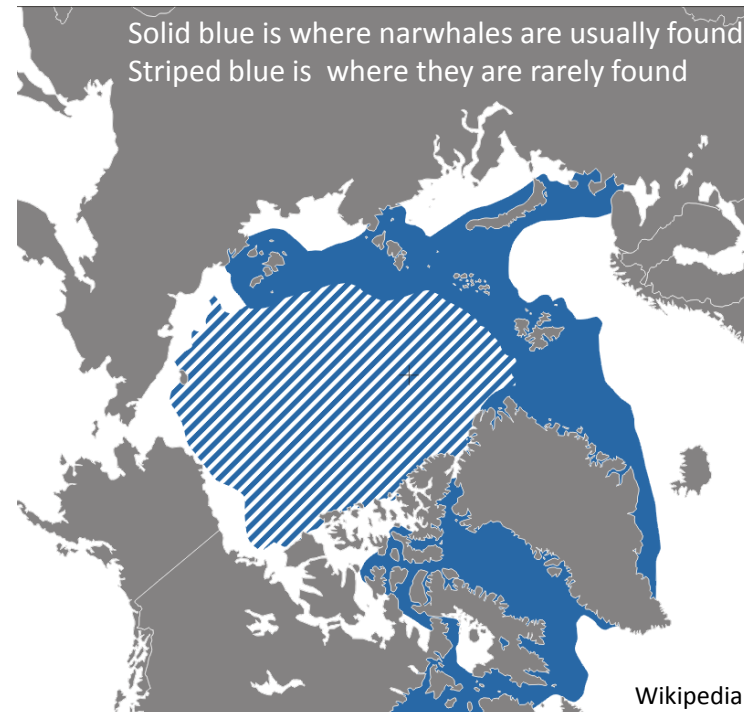


Narwhal

- The narwhal is a small whale with no dorsal fin that lives mostly in the Eastern part of the Arctic.
- The skin of adults is mottled blackish-brown.
- Young narwhals are almost black and get lighter coloured as they grow.
- Narwhal travel in small groups in winter and larger groups in summer.
- In male narwhal, one upper tooth develops into a hollow, spiralled tusk, much like the fancy feathers of a peacock that peahens don't have.
- Narwhals do not use the tusk for fighting.
- Narwhals have small teeth like beluga do but these do not usually poke through the gums, which means their mouths look toothless.
- Narwhals eat Arctic and Polar cod, shrimp, and squid.
- Narwhals are eaten by killer whales and polar bears.

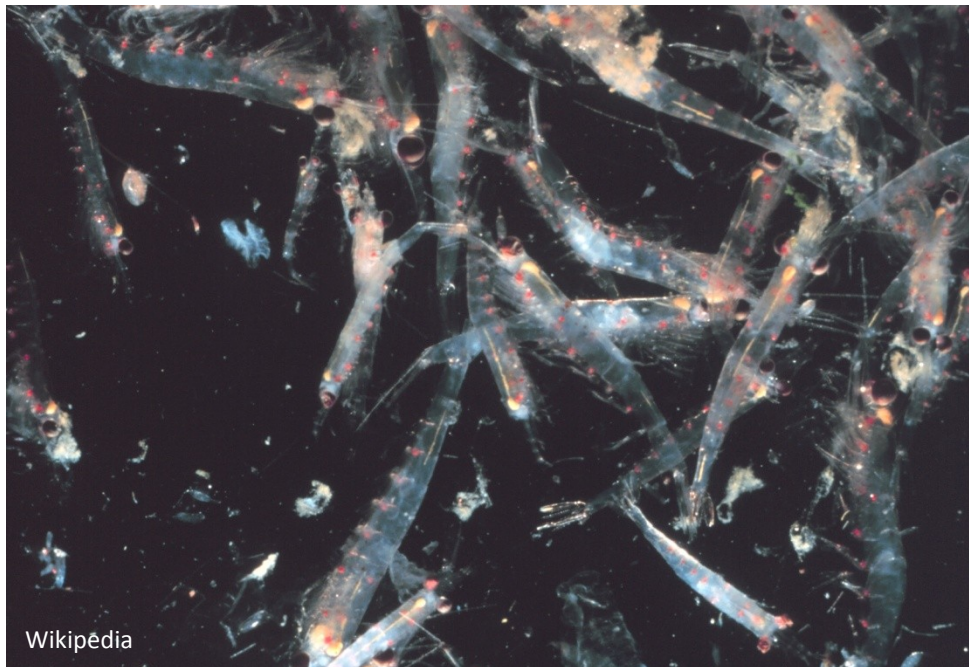


Wikipedia



Krill

- Krill is a name we use for a variety of small, shrimp-like animals that live in the open ocean and under sea ice in the Arctic.
- Krill are big enough to see without a microscope but most are only about 1 inch long (2.5 centimetres).
- Krill usually travel together in large numbers, called a *swarm*.
- Krill eat phytoplankton, fish eggs, and zooplankton.
- All kinds of krill store extra energy as fat, which is why they are such an important food source for Arctic animals.
- Krill are eaten by bowhead whales and ringed seals all year round, and by other whale and bird species that visit the Arctic in the summer.



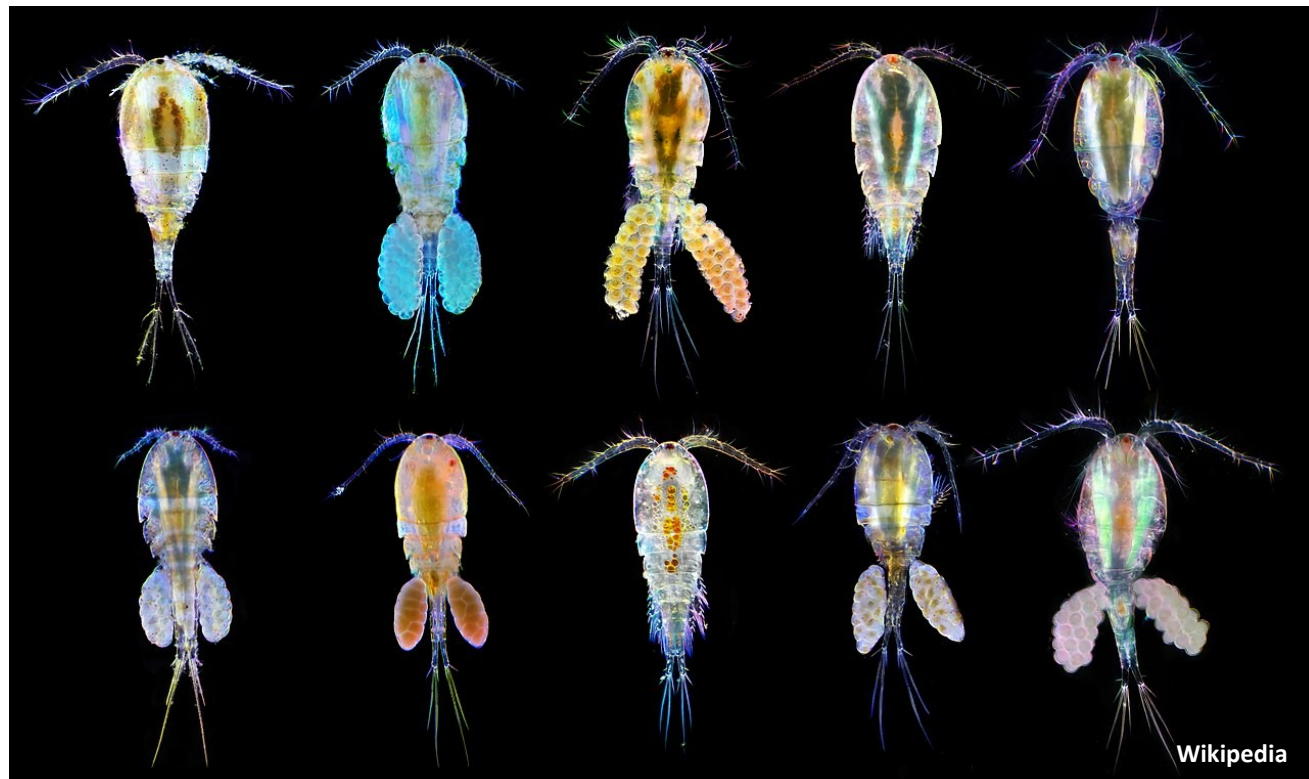
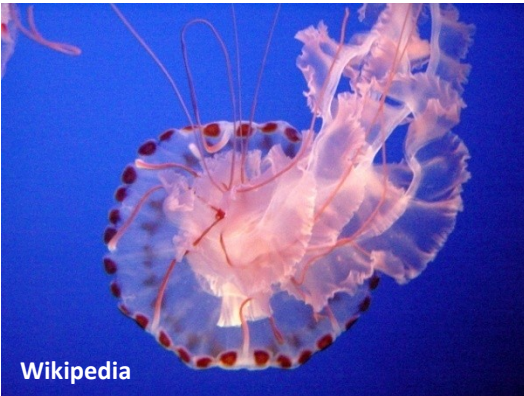
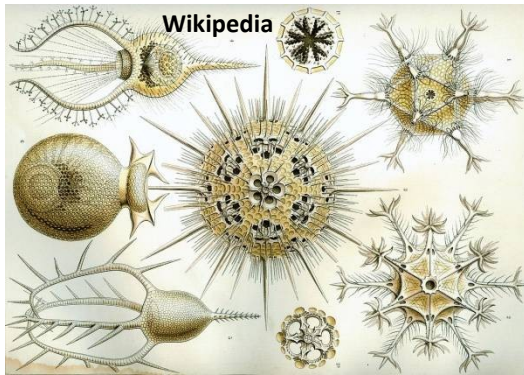
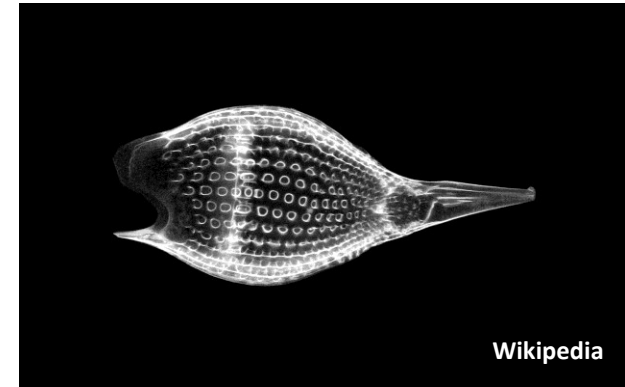
Arctic Bottom Feeders

- Many species of clams, crabs, snails, worms, sea cucumbers, and other animals live on the bottom of Arctic seas year round.
- Most of these live close to shore in shallow water.
- Many of these animals eat phytoplankton and zooplankton, but some are scavengers that eat dead animals and others are active predators that catch and eat other animals.



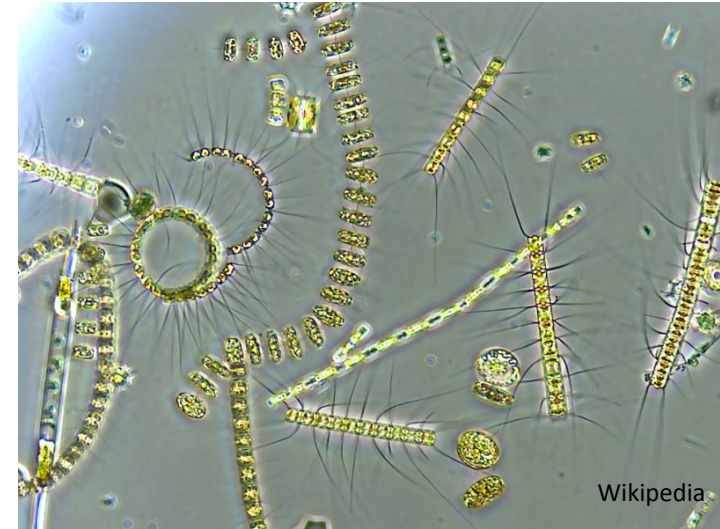
Zooplankton

- Zooplankton is a name we use for a wide variety of tiny animals that float around in the sea and under the ice in the Arctic.
- You need a microscope to see most zooplankton.
- Some look like tiny insects but others have shells that look more like weird, single-celled plants; jellyfish are also zooplankton.
- All kinds of zooplankton eat phytoplankton.



Phytoplankton

- Phytoplankton are very small plants that float around in the open ocean and under sea ice.
- There are many kinds of phytoplankton that are different shapes and sizes but all depend on sunlight to make food for themselves.
- Phytoplankton use energy from the sun to turn carbon dioxide from the air into food.
- Phytoplankton are the primary food of tiny floating animals called *zooplankton*, and of Arctic cods and krill.
- Ultimately, all other creatures in the Arctic depend on phytoplankton for food and that's why we say that these creatures are the *base* of the Arctic food chain.



Wikipedia

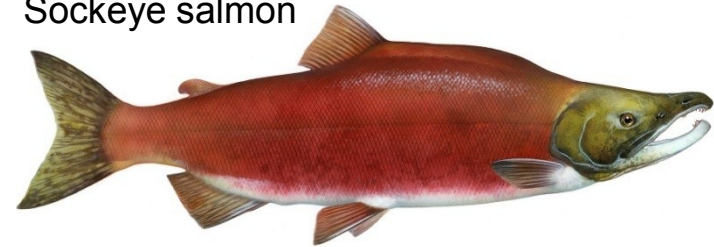


Summer visitors to the Arctic, part 1

- A number of species visit the Arctic during the summer.
- Grey whales, humpback whales and killer whales come to eat.
- Ducks, geese, gulls, terns, and other birds come to eat, lay eggs, and raise their chicks.
- Salmon come to lay their eggs.



Sockeye salmon



Killer whale (also called Orca)

DFO



Grey whale



Summer visitors to the Arctic, part 2

Common eider



Arctic tern



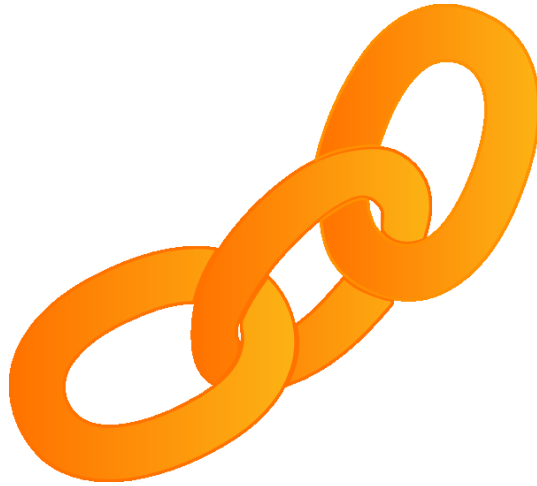
Kittywake with chicks



Snow goose



Section 8: The Arctic Food Chain



WHO EATS WHO?

How the food chain works



- Polar bears eat seals.
- Seals eat fish.
- Fish eat krill that live under the sea ice in winter or in open water during the summer.
- Krill eat phytoplankton and zooplankton that live under the sea ice in winter or in open water during the summer.
- Phytoplankton depend on sunlight that passes through sea ice in the winter or that hits the water during the spring and summer.
- All plants, including phytoplankton, convert sunlight and carbon dioxide (CO₂) from the air into food energy.
- Without carbon dioxide, there would be no phytoplankton and no plant life.
- Without phytoplankton, nothing else in the Arctic could live - there would be no polar bears.



Polar bears are *apex predators* because they are at the top of the Arctic food chain

Apex means the top

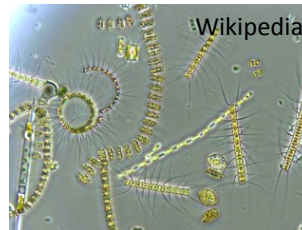


Polar bears are at the apex of the food chain; no other animal depends on the polar bear to live

SEA ICE

SEA ICE

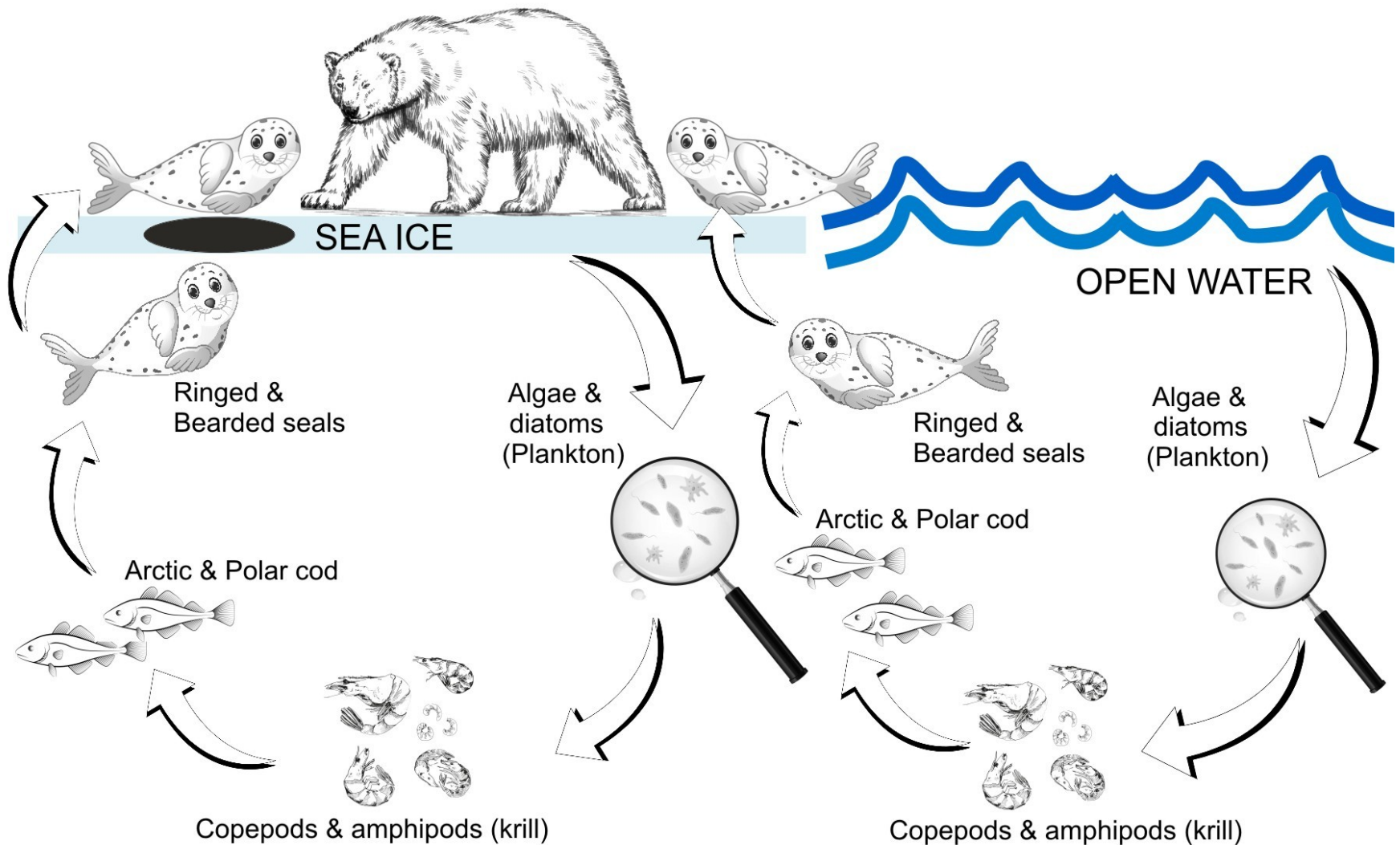
Base means the bottom



Phytoplankton are at the base of the food chain - every animal above them depends on phytoplankton to live

Phytoplankton include single-celled algae
(you can't see them without a microscope)

Polar Bears and the Arctic Food Chain



The place of other species in the food chain

- Walrus eat clams and clams eat phytoplankton
And what eats a walrus? The apex predator



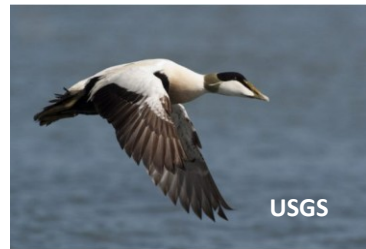
- Bowhead whales eat krill and krill eat phytoplankton
And what eats a bowhead whale? The apex predator



Section 9:

Arctic Sea Ice Ecosystem Fact Cards

Print 4 to a page



What am I?

What am I?

- I am not a living thing
- You can find me in the Arctic Ocean
- I only exist when it's very cold
- I move around when the wind blows
- Walrus use me as a resting place



I am Arctic sea ice

What am I?

- I am a marine mammal
- I eat clams from the bottom of the ocean
- I use sea ice as a place to rest
- I have front and back flippers
- I can swim in water and climb on land



I am a walrus

What am I?

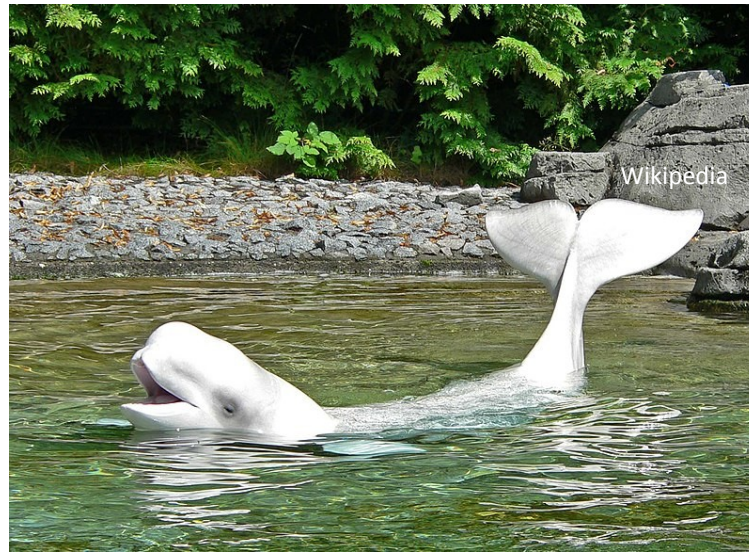
- I am a marine mammal
- I have short front flippers
- I live throughout the Arctic
- I use sea ice as a place to rest
- I am famous for my whiskers



I am a bearded seal

What am I?

- I am a marine mammal
- I am famous for my singing
- I have no hair
- I am the same colour as a polar bear
- I am smaller than an 18-wheeler



I am a beluga whale

What am I?

- I am a marine mammal
- I am an apex predator
- I have a short tail and small ears
- My babies are born in a snow cave
- I am a good swimmer



I am a polar bear

What am I?

- I am not a mammal
- I have black feet
- I live in the Arctic all year round
- I am the size of a pigeon
- I have white feathers



I am an ivory gull

What am I?

- I am not a mammal
- I live under the sea
- I am the favorite food of ringed seals
- I have scales



I am an Arctic cod

What am I?

- I live in the sea
- I come in lots of shapes and sizes
- I am the base of the Arctic food chain
- I am a plant
- I am too small to see with your eyes



I am phytoplankton