Bearly Any Ice

Grades 3-5

Lesson Summary

This game of predator and prey tag demonstrates the drastic impact of global warming by linking the amount of sea ice and length of season of sea ice to the survival of the polar bear.

Prior Knowledge & Skills

- Analysis
- Discussion
- Inference
- Kinesthetic concept development

AAAS Science Benchmarks

The Nature of Science
Scientific Inquiry
The Living Environment
Interdependence of Life
The Mathematical World
Symbolic Relationships
Common Themes
Systems
Models

NSES Science Standards

Science as Inquiry
Abilities Necessary to do Scientific Inquiry
Life Science
Characteristics of Organisms
Organisms and Environments
Science in Personal and Social Perspectives
Risks and Benefits

Teaching Time: 1.5-2 hours

Materials

- Copies of student handout
- 10 food tokens per student (pieces of cardboard)
- Gym vests or other identifying devices
- Whistle
- 8-10 hula hoops
- 4 traffic cones
- Pencil and paper
- Student data sheets
- Graph paper

Advanced Planning

Preparation Time: 10 minutes

1. Review the instructions
2. Gather the necessary supplies.

Recommended Reading: (for teachers)

- Backgrounder #1: Climate Change: What's the Big Deal?
- Backgrounder #2: The Greenhouse Effect

LASP
LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS

Bearly Any Ice

Printable Version

Grade Level: 4–12

Subjects: Sciences, Social Studies, Northern Studies

Enrichment: Social Studies, Northern Studies

Time: 1.5–2 hours

Setting: Playing field or gym

Materials: Copies of student handout, 10 food tokens per student (pieces of cardboard), gym vests or other identifying devices, whistle, 8–10 hula-hoops, 4 traffic cones, pencil and paper, student handout (data sheets), graph paper

Skills: Analysis, discussion, inference, kinesthetic concept development

Key Vocabulary: Prey, predator, adaptation, carnivore, abiotic, biotic, extinct, extirpated, cub mortality

In a Nutshell:

This game is similar to tag that simulates the prey and predator relationship between polar bears and ringed seals. It demonstrates the drastic impact of global warming by linking the amount of sea ice and length of season of sea ice to the survival of the polar bear.

Goal:

To allow students to realize the potential impact that changes from global warming will have on animals in the north.

Background Learning:

Intermediate level students should be familiar with the basic science of climate change and anticipated impacts as reviewed in:

- Intermediate Backgrounder #1: Climate Change Basics: What's the big deal? (attached at the end of this activity)
- Intermediate Backgrounder #2: Climate Change Impacts: A Changing World? (attached at the end of this activity)

Nunavut NWT Yukon

Introduction to Lesson Plan:

The polar bear is an international symbol of the Arctic and is the largest land-based carnivore in the world. Polar bears are culturally and economically important for northern people.

Climate change is already having an impact on polar bears. Warming temperatures are reducing the thickness of sea ice as well as the length of the season in which the bears can use the ice for hunting. Bears depend almost solely on the ringed seal for their food source and hunt them on the sea ice. Polar bears are unable to capture and kill seals in open water.

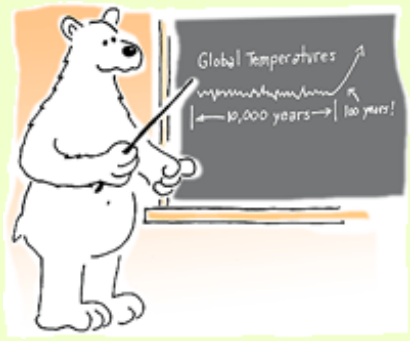
In the western Hudson Bay, the polar bear's hunting season has been shortened by three weeks over the last 20 years due to earlier ice melts. This is having a drastic impact on the bears. Bears are showing higher cub mortality, reduced weights, and reduced fat stores. During the summer, when food sources are almost non-existent, bears have survived by using the fat stores built up during the winter. Now, however, many communities are struggling with hungry bears wandering into their towns and creating hazards for humans. The reduction of sea ice could lead to the extirpation of polar bears in much of their southern range and possible extinction of the bears.

Before the lesson, look at the Bearly Any Ice Data Chart attached to this lesson as a student handout, and collect the necessary materials for the game.

This lesson was adapted from Project Wild, Canadian Wildlife Federation, Ottawa, 1992.

Activity:

1. Identify students as either polar bears or ringed seals. About two thirds of the students can be seals and one third can be polar bears. Polar bears can wear gym vests or other identifying markers.
2. Each seal is given 10 food tokens to represent the seals caught by the polar bears.



3. In a gymnasium or playing field, use the traffic cones to identify the ends as safety zones for the seals.
4. Place four hula-hoops in the open area. The hula-hoops represent areas of open water that are temporary safety zones for the seals.
5. Record the number of seals and polar bears at the beginning and end of each round on the data chart.

6. Begin the game with all the seals starting at one end of the playing field and all the polar bears scattered around the playing field. The seals will try to run to the other end of the playing field without being tagged by the polar bears. The seals can use hula-hoops as temporary safety zones from the polar bears for a maximum of five seconds before they need to move on. When a seal is tagged, they must give one of their tokens to the bear. A seal must not be tagged twice in a row by the same bear. Once a seal runs out of tokens, they are considered to have lost their life and they must move over to the side of the playing field. After all the living seals have made their way to the other end of the playing field, the leader signals for the seals to run back to the other end using a whistle blast. One round of the game runs six lengths of the gym or field. That equals one season of hunting for the polar bears.

7. At the end of a round, the polar bears are to count the number of tokens collected. In order for a polar bear to survive the season, at least four tokens must have been collected. Deceased polar bears become seals during the next round. Polar bears that collect seven or more tokens have found enough food to reproduce. Reproducing bears select one of the dead seals (or a live seal if there are no dead seals to be had) to be their cub. The cubs will not be able to hunt during their first two seasons. They will have to follow close behind their mother and hope that enough seals are caught for them both to survive. A mother will need to catch a total of six tokens to ensure that she and her cub survive the season. Record the number of polar bears and seals that survived as well as the number of cubs born at the end of each round or season.

8. At the beginning of the each round, replenish the seals' tokens to a total of ten tokens by collecting the tokens from the polar bears. All students get back in the game and are involved at the beginning of each round.

9. Repeat the game again as played before. Remind the cub polar bears that they are unable to catch seals and must only run behind their mother polar bear. At the end of the round, the polar bears count to see if they have collected enough tokens to survive – at least four for lone polar bears and six for both a mother polar bear and her cub to survive. If a polar bear has collected less than six tokens but has four or five, the cub has starved and will be returned to the seal population for the next round. If the polar bear has collected less than four tokens, then neither the mother nor the cub has survived. Once again, record how many polar bears, cubs, and seals survive. Polar bears that did not have a cub during this round will get a cub if they have seven or more tokens, just like in the first round.

10. In the next round, students are introduced to the abiotic conditions that are changing due to climate change. Two changes can now be applied to the game:

    1. Increase the number of open water safety zones for the seals by increasing the number of hula-hoops on the playing field. Try adding three more hula-hoops to the playing area.

    2. Shorten the polar bears' length of hunting season by reducing the number of times the seals have to run back and forth from six to four.

11. Continue playing the game by increasing the number of hula-hoops and reducing the number of cycles for each season. When recording the data, be sure to also record what changes have occurred in the simulated ecosystem (increased open water, shortened hunting season). Since these changes will result in poor hunting for the polar bears, lower rates of polar bear reproduction and decreases in survival rates for the bears will follow. The game may be played until almost all the bears have died to show how climate change can lead to extinction or extirpation from a particular region.

12. Return to the class in order to analyze the data collected during the game. Use Teacher Handout, Bearly and Ice Question and Answer Key to review what was learned during the game. A comparison of seal and polar bear populations can be achieved by graphing the data of the number of seals and polar bears during each round. Using a multiple line graph the students can see how populations vary. Indicate events, such as shorter rounds or the addition of hula-hoops, in order to assist in the analysis of the results.

Handouts:

These are attached at the end of this activity:

Student Handout: Bearly Any Ice Data Chart
Teacher Handout: Bearly Any Ice Question and Answer Key

Student Web-Exchange:

Students can post the findings from their game on the student exchange portion of the website.

Students could host a discussion forum encouraging other students to try the game and to share information about their communities related to the polar bears. Discussion questions might include: Is there polar bear hunting near your community? Has the quota for polar bear hunting been reduced in the past few years? Have incidents of polar bears wandering close to town in search of food increased over recent years? When does the ice form in your area and when does it melt?

Click on the icon for information on how to post material.

Evaluation:

1. Students could analyze results after playing another game and make inferences about the changes that were made to the game.
2. Provide students with fictional data and have the students explain possible changes that resulted in the fluctuations of the data.

Enrichment Ideas:

Social Studies and Northern Studies:

Ice Watch: Track the formation of ice and break up of ice near your community. Register with http://www.naturewatch.ca/english/icewatch/ and submit your dates.

How Healthy is that Bear?: Use the Quetelet Index to demonstrate how scientists monitor polar bears health. http://www.tv.cbc.ca/national/pgminfo/warming/bears.html

Hunting Restrictions: Debate laws that restrict the hunting of animals such as polar bears. Should hunting tags be issued to local people to use or should they be sold to sport hunters?

Language Extension:

Write a letter to your future grandchild who may never see a polar bear.

More Information:

Global warming could starve polar bears
http://news.bbc.co.uk/1/hi/sci/tech/521451.stm

Global Warming Impacts: Polar Regions
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsPolarRegions.html

The Shrinking Polar Bear: CBC Special
http://www.tv.cbc.ca/national/pgminfo/warming/bears.html

Report says Arctic warming imperils polar bears
http://www.planetark.org/dailynewsstory.cfm/newsid/15956/story.htm

Polar Bear Headed For Extinction
http://www.scienceagogo.com/news/20030008220241data_trunc_sys.shtml

About the Author:

My name is Peter Maguire and I live in Taloyoak, Nunavut. Taloyoak is a community of about 750 people located on the isthmus of the Boothia Peninsula. Taloyoak is 95% Inuit and is the most northern community on Canada's main land. I teach grades 6–12 (Science & Math) at Netsilik School (http://www.polarnet.ca/~netsilik). This is my eleventh year teaching in Taloyoak. I enjoy the great landscape and spend countless hours hiking and skiing with my three dogs.

Student Handout

Bearly Any Ice Data Chart

Year	# of Rounds in Year	# of Hula Hoops	# of Adult Polar Bears at Beginning of Round	# of Surviving Adult Polar Bears	# of Cubs at beginning of round	# of Surviving Cubs	# of Cubs Born	# of Seals at Beginning of Round	# of Seals at End of Round
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2									
3									
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Bearly Any Ice – Question and Answer Key

1. How did the length of each round affect the polar bears' chances of catching enough seals to survive?

   Answer: The shorter the round, the more difficult it was to catch the number of seals required.

2. What change in the ecosystem does a shorter round represent?

   Answer: The shorter round is equivalent to a shorter season of annual ice. This shorter season reduces the time for polar bears to acquire the food they need for survival.

3. How did the number of hula-hoops affect the polar bears' chances to catch the required amount of seals in order to survive?

   Answer: The more hula-hoops, the more safety zones become available for the seals (i.e. open water), therefore increasing the seals' chance of survival and increasing the difficulty for the polar bears to find the food needed for survival.

4. What change in the ecosystem does increased numbers of hula-hoops represent?

   Answer: More hula-hoops reflect greater amounts of open water for the seals to take protection from the polar bears.

5. If the sea ice continues to vanish, what may be the ultimate fate for the polar bear?

   Answer: The polar bear could become extinct or at least extirpated from their southern range.

6. Could the polar bears adapt in order to survive?

   Answer: The bears could find other sources of food or methods of hunting. However, adaptation usually takes a very long time and the changes brought on by global warming have been relatively fast compared with rates of adaptation.

7. What economic and cultural impact would the loss of the polar bear have for northerners?

   Answer: Many communities have active sport hunting and eco-tourism businesses that depend on world interest in the polar bear. The polar bear is also of great cultural importance to Inuit including: legends, hunting skills development, clothing and food sources, as well as traditional rites of passage into adulthood.

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Basics of Climate Change
Intermediate Backgrounder 1

Climate Change Basics: What's the Big Deal?

What is climate change?

Climate change is different from the changes in weather you see from day to day. It's the kind of change in weather patterns your parents or elders may have noticed. You may have heard them say that winters aren't as cold as they used to be, or that the ice is thinner on the lakes and in the Arctic. Scientists agree with them. The climate is changing. And it's changing more quickly in the north than anywhere else.

Up until the last hundred years or so, the earth's climate stayed much the same – for almost 10,000 years. Sure, there were some weird winters and really hot summers, and some cold stretches, but temperatures averaged out over the years, and you knew what to expect season to season. Little changed until about a century ago when the average temperature of the globe started to rise.

Over the last century, average temperatures in many Arctic regions climbed by as much as 5°C. The average worldwide temperature increased about 0.6°C.

Some scientists predict that, if these changes continue over the next 100 years, temperatures in the Arctic could rise by as much as twice the global average – and that's expected to go up by 1.4° to 5.8°C.

That doesn't sound like a problem, does it? Don't people in the North deserve a break from long, cold winters? Maybe – but climate change means a lot more than warmer temperatures. It may change many of the things we value about the north - our environment and plants and animals. That makes climate change something worth checking out.

Greenhouse Gases – the Earth's Blanket

To understand climate change, you have to know something about our atmosphere. Even though we can breath it and see through it, as far as the earth is concerned, the atmosphere works like a blanket. It's made up of the air we breathe, plus small amounts of greenhouse gases (GHGs) that can trap heat like a warm, fleecy blanket. If you are chilly at night and cover up with a blanket, the warmth given off by your body gets trapped by the blanket and keeps you cozy. GHGs in the atmosphere do the same thing for the Earth. They trap some of the heat that the earth absorbs from the sun. This trapping of warmth is known as the 'greenhouse effect.'

If the earth's atmosphere didn't have some greenhouse gases, heat would be lost to space and we'd have temperatures more like those on Mars. There, they go up to 37°C during the day - bathing suit weather - but down to, more than minus 100°C at night – tough to survive. The greenhouse gases in our atmosphere help make life on earth possible.

Too Many GHGs – Too Many Blankets

The amount of greenhouse gases we had in the atmosphere for about 10,000 years helped to keep the climate pretty much the same over that period of time. The earth's environment, plants and animals (including us) adapted to that climate. A change in the amount of greenhouse gases could mean too much heat – or too little. That could affect us, and other life on the planet, by changing our environment.

Greenhouse gases need to be kept in a delicate balance. And more greenhouse gases could be too much of a good thing.

Why are we warming up?

Right now, human activities are tipping the balance of gases in the atmosphere. They are changing our climate. We are adding too many heat-trapping greenhouse gases to the atmosphere. The result is some very weird weather – more heat, more storms, more rain in some places and seasons, and more drought and unusual temperatures in others. This build-up of GHGs and what it does to our climate is sometimes called the "Enhanced Greenhouse Effect."

So, what's a few degrees?

A few degrees up or down don't make a big difference day-to-day or even year-to-year. But over many years, it can be a big deal. During the last Ice Age, the earth's average temperature was only 4° to 6°C cooler than it was for the last 10,000 years – that stable climate period we've talked about. During that Ice Age, a thick sheet of ice covered nearly all of Canada, and many plants and animals disappeared completely. So a few degrees can make a big difference over the long haul.

Where Are all these GHGs Coming From?

About 200 hundred years ago, humans began to develop faster ways of making and moving things. This period of time was known as the Industrial Revolution.

The energy that made the revolution possible came from "fossil fuels." These are fuels such as coal, and the diesel oil, furnace oil, kerosene and gasoline that come from petroleum.

When we use fossil fuels to run our cars, trucks, boats, airplanes and snowmobiles, we release greenhouse gases. We may also release GHGs when we heat our homes, run our industries, or generate electricity.

Let's look at the major greenhouse gases and see why more of them are going into the atmosphere.

Greenhouse Gases:

Water vapour

If you have gone into a bathroom after someone has showered and felt dampness in the air, then you have been surrounded by water vapour. Water vapour is part of the world's water cycle. When water in rivers, lakes and oceans warms up, it evaporates. It becomes a gas – water vapour – and rises into the atmosphere. Sooner or later it comes back down as rain or snow. It collects in rivers, lakes and oceans as part of a natural cycle that will always continue. In the atmosphere, water vapour can form clouds. They can act like a blanket and trap heat close to earth. Clouds can also reflect heat from the sun back into space. There is more water vapour in our atmosphere than any other greenhouse gas.

Carbon Dioxide (CO_2)

Carbon Dioxide (CO_2) is the second most common GHG. Many natural processes put carbon dioxide into the atmosphere. Humans and animals breathe out carbon dioxide, and forest fires, volcanoes, and rotting trees and plants release it. Natural levels of CO_2 in the air are important for life, but too much of it can tip the balance.

If you have smelled the fumes from a car or snowmobile, you have also breathed in carbon dioxide (CO_2) at the same time. Humans produce CO_2 whenever we burn fossil fuels. And we burn them whenever we drive our vehicles, heat our homes, run our industries or fly airplanes. In many northern communities, we produce CO_2 when we burn diesel to make electricity. The carbon dioxide produced by human activities is the main reason our climate is changing, and changing fast!

Methane and Nitrous Oxide

Methane and nitrous oxide are two other important greenhouse gases. They're a small part of our atmosphere, but they can trap a lot of heat. In fact, methane is 21 times more powerful as a greenhouse gas than CO_2, and nitrous oxide is 310 times more powerful!

Large-scale farming and garbage dumps produce lots of nitrous oxide and methane. When farmers put nitrogen fertilizers on the soil to help plants grow, nitrous oxide is released. When cattle digest their food, they let out a lot of methane. With over three million cattle in Canada – that is a lot of gas! When food scraps in our garbage dumps rot, they produce methane, too. (When you don't waste food and compost food scraps so air can mix with them, you cut down on methane production!)

Find out what climate change does:

As you can see, some GHGs occur naturally, but human activities are putting more GHGs into the atmosphere and changing our climate. To read more about the effects of GHGs and climate change, read **Backgrounder 2 – Climate Change Impacts: A Changing World.** To see what you can do to help slow down GHG production, read **Backgrounder 3 – Climate Change Solutions: We can all help!**

Hot Facts

- Canada produces only two and a half per cent of the world's GHG emissions. But per person, it is the world's third largest producer of greenhouse gases after USA and Australia.
- North Americans throw away about two kilograms. of garbage every day. When all that garbage sitting in the dump starts to decompose, it produces methane gas.
- Nine of the ten hottest years on record have taken place in the 1990s. 1998 is thought to have been the warmest year yet.

Key Points

- The earth is heating up all over, and especially in the north.
- The atmosphere helps trap the heat of the sun close to earth, just like a blanket traps heat from your body – this is called the "greenhouse effect."
- Too many greenhouse gases in our atmosphere are increasing the earth's temperature and causing the earth's climate of the earth to change.
- The main GHGs are water vapour, carbon dioxide (CO_2), methane and nitrous oxide.
- Carbon dioxide gas is produced when people burn fossil fuels – gas, coal and oil.
- Some of these are created naturally, but many are sent into the atmosphere by human activities – our burning of fossil fuels to power our cars, heat our homes and run our factories.

Want to know more?

Here are some websites to help you learn more about climate change and the greenhouse effect:

General

- **EduGreen:** http://edugreen.teri.res.in/explore/climate/climate.htm

- **Government of Canada Climate Change Website:** http://www.climatechange.gc.ca/english/index.shtml

Greenhouse Effect & GHGs:

- **Cool Climate Kids' Club (It's a Gas!):** http://www.coolclimate.org/itsagas.htm – A good explanation of GHGs.
- **EPA Kids' Site (Greenhouse Effect):** http://www.epa.gov/globalwarming/kids/greenhouse.html
- **Solar School:** http://das.ee.unsw.edu.au/~solar/classrooms/1_1.html

Printable Version

Impacts of Climate Change
Intermediate Backgrounder 2

Climate Change Impacts: A Changing World?

Why is Climate Change Such a "Hot" issue for the North?

Scientists expect northern regions to warm up more than other parts of the world as the earth's climate changes. If you've flown over the Arctic, or over other parts of the north during the winter, you might know why. Snow and ice act like mirrors. They reflect a lot of the sun's heat. But, as the world gets warmer, a lot of snow and ice will melt. This means that darker land and open water will soak up more of the sun's heat.

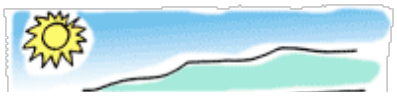
More heat held by earth and water, means later winters and earlier springs. Temperatures will rise more in the north than in other parts of the earth. This will mean changes to our environment. And those changes will affect the plants and animals that have adapted to it.

Climate change could mean big differences to life in the north. It may change the land on which we travel and build our homes. Scientists and people on the land have already noticed differences in the ice on our rivers, lakes and seas.And warmer temperatures will affect plants and trees. All of these changes are bound to affect animals, fish, birds and sea mammals – and possibly our own way of life in the North.

We can't ignore climate change, but we can learn more about what may happen as it changes.

Part 1 – Changing Land

Melting Permafrost



Most of the North has a layer of permanently frozen ground just under the top layer of soil. While the top layer of soil thaws every summer and supports plant life and trees, the permafrost (permanent frost) underneath never thaws. As

temperatures rise due to climate change, permafrost may thaw. This is especially likely to happen where ground has been disturbed around our communities. That means that the ground could turn soft and mushy. Roads and airstrips could turn into roller coasters. Buildings, water lines and power poles could tilt and gradually break or fall as the ground thaws and collapses. Melting permafrost could also make it harder for migrating animals and hunters and gatherers to travel over soft, uneven ground.

Drying wetlands

Wetlands, such as sloughs and marshes, are an important part of the land around us. They offer summer homes, complete with nesting and feeding areas, to lots of migratory birds. As the land and air heats up, some wetlands will dry up or shrink because more water will evaporate. Others may disappear for a different reason. Many wetlands are hollows in the permafrost. If the permafrost melts, they may just drain away. That would be bad news for wetland birds and mammals.

What about the ice?

We all know that when you heat ice, it melts. People are already noticing earlier spring break-ups on rivers, lakes and even on parts of the Arctic Ocean. When ice and snow on land melt, water levels in lakes and rivers rise, sometimes causing floods. Sea ice is breaking up earlier, thinning out, and covering less ocean surface during the summer months.

Less ice means it's harder for trappers, hunters and animals to get around during the winter. When ice is thinner, it makes travel more dangerous. More open water along the Arctic coast, means more lapping or crashing against the shore. When you add that to melting permafrost, you can get collapsing coastlines. Some communities located on the coast may have to plan for big changes.

Everything is on the move

Humans aren't the only creatures that have to adjust to a changing climate. Warmer temperatures are making it easier for some southern species of plants and animals to survive farther and farther north. At the same time, some northern plants and animals are finding it harder to survive as their environment changes.

If northern waters warm as a result of climate change, fish that like to live in warmer water may survive farther north. But fish such as salmon, cod and arctic char already live in the north and need colder waters to survive. As cold-water areas warm and southern species move in, cold-water fish might have a harder time making it.

Changes in climate also mean that animals are on the move. People are seeing moose and other animals, such as coyotes, white-tailed deer and cougars, farther north than ever before. Riding piggyback on these animals are smaller critters like parasites and insects that never used to live as far north. Different kinds of birds are also moving north with warmer weather.

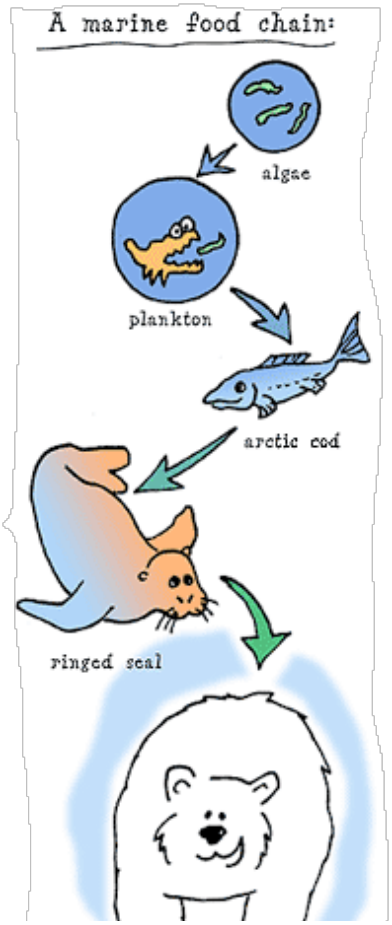
Although plants can't get up and walk to a new home, their seeds fly on the wind, float on rivers and ride in the fur of animals looking for new homes. If the climate is warmer, they may be able to put down roots further north.

When new plants move in, they sometimes crowd out the plants that were there before. With higher temperatures, plants like willows are moving north into areas of tundra. This could make it hard for some animals like caribou to find enough of their normal food. On the other hand, animals may be able to eat sooner in the spring – if plants green up earlier because of warmer temperatures. That's a bonus when bellies are at their emptiest!

Part 2 – How Will Climate Change Affect Northern Animals & People?

What about marine life?

In the Arctic, polar bears eat seals, seals eat codfish, cod eat plankton, and plankton eat algae. This set of links between the eaters and eaten is called the food chain. The food chain in the Arctic is short and each link in the chain is important. This is especially true for marine life. Every link in the food chain depends on every other link.



Animals in the Arctic food chain depend on the particular climate of the Arctic – some more than others. If warmer temperatures affect one part of the chain, they may affect the entire marine ecosystem. Warmer temperatures, thinner ice and more open water, for example, affect several marine animals.

Seals and walruses mate and have their babies on the sea ice. One effect of thinning ice could be lower birth rates. Seals and walruses also rest and hunt from the ice. As it thins, they won't have as good a base for resting and hunting. And as the ice melts away from shore, they'll end up hanging out over deeper waters. That's a problem when they usually depend on shallow water for their munchies. These two changes could make feeding a lot more difficult.

Polar bears will be affected by what happens to the ice and the seals. As the ice melts earlier in the spring, and the edge of the icepack gets farther away from land, polar bears have a harder time reaching the seals that they eat. This has already happened in the Hudson Bay region. There, polar bears are having trouble reaching the seals they usually fatten up on in the spring. That's why scientists report lower weights and birth rates for polar bears in that region.

What about caribou?

Animals on land may be in for trouble, too. Barren ground caribou in northern Canada travel great distances every year, from wintering grounds to calving grounds to insect relief areas and back again. These days, caribou are running into snow that is deeper and heavier than it used to be. Caribou may have to burn more energy breaking through harder, crusted snow to eat. Thinner ice on lakes and rivers and earlier break-up make river and lake crossings trickier. More caribou are likely to break through and drown as a result. On the plus side, caribou may find that some of the plants that they eat will green up earlier in the spring. However, the same warmer temperatures that help plants may also help insects to hatch sooner. That means that caribou could be chased out of their calving areas earlier than usual.

What about the little critters?

If climate change makes snow icier, as some scientists expect, smaller mammals may find it difficult to live and breath under the snow. If they have trouble surviving, the animals and birds that live on small mammals – foxes, for example – could have a tough time.

What about birds?

In the Eastern Arctic, climate change has meant cooler weather. That's why some birds, like snow geese, have been nesting farther south than they used to. But continuing climate change is likely to warm this region in coming decades. In parts of the Arctic that have already warmed, people are seeing new duck species that used to stay farther south.

What about Northern communities?

A warmer climate is going to have a mix of positive and negative impacts on our communities. Melting permafrost will cause some of the biggest changes. It could affect our roads, buildings and industries. People who spend time on the land are already noticing changes- particularly to ice conditions –- that affect their hunting and trapping lifestyles. If we're smart, we'll prepare for changes that may be coming, even if we can't be a hundred percent sure what they'll look like.

What about the rest of the world?

The climate is changing everywhere. People around the world will have to deal with many of the same types of impacts as northerners. For example, worldwide, new plant and wildlife species will appear in some areas. Familiar species will disappear if they can't handle the new climate.

Around the world, many cities, towns and villages are built close to sea level. Scientists expect climate change to cause sea levels to rise. This means that tens of millions of people who live close to the sea will have to move to higher ground. Whole islands or countries could disappear under water. Salt water could flood low-lying farmland and displace fresh water. This would harm farm crops because many plants can't grow in salty soil.

Climate change is expected to mean very unreliable weather. Some parts of the world will get more rain and floods. Other parts will get more droughts and really hot weather. When it gets really hot and dry, more water evaporates. That means less drinking water for people and less water for farm crops and animals. Some countries may find it even more difficult to feed and house their people.

Sounds like disaster!

Most of this is not good news for our planet. And it means major challenges for the animals, plants and people that live here. But don't despair. There are things that people can do – and are doing – to help slow climate change and reduce its impacts. Read about them in **Backgrounder 3 – Climate Change Solutions: We Can All Help!**

Key Points

- A changing climate means that there will be big changes to land, water, plants and animals.
- Climate change is already having an impact on the north. Permafrost is melting, wetlands are drying up, sea ice is melting and sea levels are rising.
- Plants will grow earlier in the spring and new plants will grow in the north that never grew here before. Some southern animals such as moose, coyotes, white-tailed deer and cougars will move farther north too!
- Some northern animals such as cold-water fish, caribou, small mammals and polar bears may find it very hard to adapt to rising temperatures.
- Communities in the north and all over the world face big changes due to climate change. Everyone needs to think about how they will adapt to the changes.

Want to know more?

These websites will help you learn more about the impacts of climate change in the north and around the world:

- **Arctic Borderlands Ecological Knowledge Co-op:** http://www.taiga.net/coop/indics/ocduck.html
- **CBC TV (The Shrinking Polar Bears):** http://www.tv.cbc.ca/national/pgminfo/warming/bears.html
- **Government of Canada Climate Change Website (How will it affect us?):** http://www.climatechange.gc.ca/english/affect/

- **Climate Change in Canada Poster Site:** http://adaptation.nrcan.gc.ca/posters/
- **EPA Global Warming Kids' Site (So What's the Big Deal?):** http://www.epa.gov/globalwarming/kids/bigdeal.html
- **Polar Bear Tracker:-** http://www.panda.org/polarbears/
- **Taiga Net: Caribou:** http://www.taiga.net/caribou/pch/slides/index.html