



Bearly Any Ice

The predator-prey relationship between polar bears and ringed seals is simulated in this active tag game. It also demonstrates the dramatic impact of increasing global temperature on polar bear survival by linking changes in food availability to the quality and duration of the sea ice each year. Through this activity, students can realize the impacts that climate change will have on animals and ecosystems.

Activity Time

- Warm-up: 15 – 45 minutes, depending on students' prior knowledge
- Activity: 30 – 40 minutes
- Wrap-up: 20 minutes

Setting

- Large open space in gymnasium or outdoor playing area
- Classroom (introduction and debrief)

Materials

- *Bearly Any Ice Data Chart* Black Line Master (BLM)
- clipboard
- 10 food tokens per student (e.g., pieces of cardboard or recycled playing cards)
- 8 - 10 hula-hoops
- 4 cones for marking boundaries
- gym vests or other identifying markers
- whistle
- pencil and paper
- graph paper

Subjects

Science, Social Studies, Language Arts, Math, Physical Education

Keywords

Prey, predator, carnivore, food chain, population, species, adaptation, habitat, ecosystem, abiotic, biotic, extinct, extirpated, cub mortality

Prescribed Learning Outcomes - Science:

Life Science

- Analyse the roles of organisms as part of interconnected food webs, populations, communities, and ecosystems
- Assess survival needs and interactions between organisms and the environment
- Assess the requirements for sustaining healthy local ecosystems
- Evaluate human impacts on local ecosystems

IRP Curriculum Organizers:

Language Arts

- Oral Language
- Reading and Viewing
- Writing and Representing

Social Studies

- Human and Physical Environment

Introduction and Background

See the *Primer* for information on climate change, greenhouse gases, greenhouse effect, and impacts on ecosystems; this information is also included in the lessons *Greenhouse Effect, Parts One and Two* and *Carbon Cycles!*

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. Polar bears hunt their primary prey, ringed seals, on the sea ice that covers much of the Arctic Ocean during fall, winter and spring. Polar bears are unable to capture and kill seals in open



Bearly Any Ice

water. Warming temperatures are decreasing the thickness of the sea ice thereby reducing the polar bear’s access to the breathing holes of ringed seals. 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 melting of the sea ice.

These changes in the sea ice are having a drastic impact on the bears. They are showing higher cub mortality, reduced body weight, and reduced fat stores. During the summer, when alternative food sources are almost non-existent, polar bears survive by using stored body fat that was built up during the winter. Many northern communities are currently struggling with hungry bears that wander into their towns seeking food, thus creating hazards for humans and bears. The reduction of sea ice could lead to the extirpation of polar bears in much of their southern range and possible extinction of polar bears.

For more information on polar bears, the arctic and sea ice ecosystems, and climate change see:

The Climate Change Institute

<http://www.climate.org/topics/climate-change/polar-bears-climate-change.html>

World Wildlife Fund

<http://www.ngo.grida.no/wwfap/polarbears/risk/index.html>

Polar Bears International

<http://www.polarbearsinternational.org/bear-facts/climate-change/>

Procedure

Set-up

- 1 Before the lesson, print the *Bearly Any Ice Data Chart* Black Line Master (BLM). Place on the clipboard.
- 2 Collect and/or prepare the necessary materials for the game. Recycled plastic playing cards can be cut in half for use as tokens.
- 3 Set out cones to mark the boundaries of a large, rectangular shaped playing area in the gymnasium or playing field.

Scatter four hula-hoops within the playing area.

Warm Up

- 1 Ask the students what they know about the arctic sea ice ecosystem. Guide them to identify and describe the major organisms and their ecological role in the ecosystem (e.g., producer, consumer or decomposer). Be sure to identify algae as the major producer under the sea ice. *See the Primer for more information about food webs and ecological roles.*
- 2 Ensure students understand that polar bears primarily eat ringed seals and that they are a top predator in this ecosystem. Briefly describe how and when polar bears hunt their prey, noting the limited time available for hunting, and how polar bears rely on stored body fat to sustain them through the summer. Also discuss how females rely on stored body fat to raise their cubs in maternity dens throughout the winter and do not feed again until spring.
- 3 Introduce the concept of energy flow through ecosystem food chains and food webs. Explain how light energy is transformed into chemical energy (photosynthesis), which is transformed into mechanical energy in a living creature as it breaks down the chemical bonds in carbohydrates (respiration). *See the Primer for more information.*
- 4 Working in groups, ask the students in each group to determine one of the possible food chains in this ecosystem. Review each group’s work to ensure they are creating a realistic food chain.

An example of one possible food chain begins with the producer (algae under the sea ice). Stored energy is passed to small invertebrates in the water (zooplankton; primary consumer), to arctic cod (secondary consumer), to ringed seals (tertiary consumer) and finally to a top predator such as a polar bear.

Ask the groups to present their food chain verbally. As they do so, record them on the blackboard or chart paper and arrange the food chains into a food web by adding connecting lines.





Bearly Any Ice

5 Ask the students what they know about climate change and its impacts on polar bears. Based on the students' prior knowledge, review and/or clarify the concepts of climate change, greenhouse gases and greenhouse effect. *See the Primer for more information.*

Activity

1 Divide the class so about **two thirds** of the students are **ringed seal players** and **one third** are **polar bears**. Polar bears should wear gym vests or other identifying markers. **Choose one person** to record the data for each round (season) of the game on the *Bearly Any Ice Data Chart* (BLM); this could be the leader. Alternatively, have individual or pairs of students record the data.

2 Give each **seal player 10 tokens**. A seal player represents a group of 10 seals. Each time a seal player is tagged by a polar bear, one of the tokens is given to the polar bear to represent that one seal has been eaten.

3 Identify the boundaries and safety zones of the playing area in the gymnasium or outdoor playing field.

Each **end** represents **open ocean**; these are permanent **safety zones** (shelter) for the seal players where they cannot be tagged.

The **four hula-hoops** within the playing area are **temporary safety zones** for the seal players. The hula-hoops represent **areas of thin sea ice** where polar bears cannot capture the ringed seals.

4 Explain how the game is played to the students.

All the **seal players** start in the open ocean at one end of the playing area.

The **polar bears** start spread out within the playing area; they must stay in the playing area throughout the game.

During each **season of hunting** for polar bears, the **seal players** try to **run** from one end to the other end of the

playing field **six times** (three return trips) without being tagged by the polar bears. (Though not ecologically accurate, for the purposes of this game both seals and bears are on top of the ice.)

Upon reaching one end, seal players must wait until all the seal players reach that end (unless they have lost all their tokens). The leader will signal (e.g., with a whistle) for the seal players to run to the other end.

The seal players can **temporarily seek shelter** in an area of thin sea ice (safety zone) from the polar bears by placing both feet in a hula-hoop for a **maximum of five seconds** before they must move on.

When a **seal player is tagged**, they must **give one** of their **tokens** to the bear. A seal player cannot be tagged twice in a row by the same bear.

Once a seal player runs out of tokens, they are dead and must move over to one side of the playing field.

5 Record the number of seal players and polar bears on the *Bearly Any Ice Data Chart*.

6 Play the game for one hunting season; stop the play at the end of the sixth trip of the seal players.

7 At the end of the first season, count the number of tokens collected by each polar bear. The number collected will determine the fate of the polar bear during that season.

If a polar bear has **three or fewer tokens**, it did not eat enough to survive. The **deceased polar bear now becomes a seal player** in the next season.

If a polar bear has **four, five or six tokens**, it ate enough seals to **survive** into another season.

Polar bears that collected **seven or more tokens** found enough food to **reproduce**. Reproducing bears select one of the dead seals (or the live seal with fewest tokens if





Bearly Any Ice

there are no dead seals to be had) to be their cub during the next season.

The cubs will not be able to hunt during their first two seasons. They must follow close behind their mother and hope that enough seals are caught for them both to survive.

8 Record the number of adult polar bears and seal players that survived as well as the **number of cubs born** on the *Bearly Any Ice Data Chart*. (Alternatively, for more accurate data, record the total number of tokens remaining in the possession of the seal players. This indicates the number of actual seals remaining in the population.)

9 Before starting the second season and subsequent seasons:

- collect all tokens from the polar bears,
- **replenish the seal players' tokens** to a total of ten tokens,
- ensure all students have a role and are ready to play again,
- **record** the number of adult and cub polar bears and seal players, and
- remind the cub polar bears that they are unable to catch seals and can only run closely behind their mother polar bear.

10 Play the game again for another season.

11 At the end of the season, polar bears again **count the tokens collected**.

If the **polar bear was solitary** (without a cub), their survival fate is the same as in the first season (see step 7 above), including gaining a cub if more than seven tokens were collected.

If the **mother polar bear with a cub** has collected **three or fewer tokens**, then **neither the mother nor the cub survived**. Both become seal players in the next season.

If a **mother polar bear with cub** has collected **four or five tokens**, the **cub has starved** and returns to the seal population for the next season.

Both cub and mother **survive** if **more than six tokens** were collected. The mother does not reproduce again in this season.

12 Record the number of adult and cub polar bears and seal players that survived as well as the number of cubs born on the *Bearly Any Ice Data Chart*.

13 Repeat playing the game for another few seasons, as time permits, following steps 9 through 12 for each season. Note, if a cub survives two seasons, in the following season it becomes an adult polar bear.

14 Introduce the impact of climate change by changing the condition of the sea ice. Two changes can now be applied to the game:

Increase the number of areas of thin ice (temporary safety zones) for the seals by increasing the number of hula-hoops on the playing field. Try adding two or three more hula-hoops to the playing area initially.

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

15 Restart the game from the **beginning** with one-third of the class representing polar bears and the other two-thirds seal players. **Play the game** for a few seasons, increasing the number of hula-hoops and/or reducing the number of runs for each season.

16 When recording the data, be sure to also **record what changes** have occurred in the simulated ecosystem (increased thin ice, shortened hunting season). Since these changes will result in poorer hunting for the polar bears, a lower rate of polar bear reproduction and decrease in survival rate for the bears will follow.

17 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.



Bearly Any Ice

Wrap-up

1 Compare the data from the first part of the game to the second part when climate change impacts were introduced. A comparison of seal and polar bear populations can be achieved by graphing the data of the number of seal players (or number of tokens representing seals) and polar bears during each season. Using a multiple line graph the students can see how populations vary. Indicate events, such as shorter season or the addition of hula-hoops, in order to assist in the analysis of the results.

2 Debrief the game by asking the students the following questions.

How did the length of each season affect the polar bears' chances of catching enough seals to survive? **Answer:** *The shorter the season, the more difficult it was to catch the number of seals required to survive.*

What change in the ecosystem does a shorter season represent? **Answer:** *The shorter season is equivalent to a shorter length of time of annual sea ice that is suitable for hunting on. This shorter season reduces the time for polar bears to acquire the food they need for survival.*

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., areas of thin sea ice), therefore increasing the seals' chance of survival due to the increasing difficulty for the polar bears to access and find the food needed for survival.*

What change in the ecosystem does increased numbers of hula-hoops represent? **Answer:** *More hula-hoops reflect greater areas in which the seals can feed safely from the polar bears as a result of climate change and the melting of sea ice.*

3 Discuss the impact of climate change on the habitat and future of polar bear populations by asking the following questions.

If the sea ice continues to vanish due to climate change, what may be the ultimate fate for the polar bear? **Answer:** *The polar bear could become extinct or at least disappear from their southern range (extirpated).*

Could the polar bear populations adapt in order to survive? **Answer:** *Some populations of polar bears potentially could find other sources of food or methods of hunting. However, adaptation usually takes place over many generations and the changes brought on by climate change have been relatively fast compared with rates of adaptation.*

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

4 Explore the potential impact that the loss of polar bears as a top predator may have on the food chain and food webs in the arctic sea ice ecosystem.

Assessment

1 Students research and report on a top predator in their local ecosystem that is potentially threatened or endangered due to changing factors within their habitat/ ecosystem due to climate change or other reasons. The report should include what impact the loss of this species may have on other species (impact on food web), including overall biodiversity in the ecosystem. Include in the report an "advertisement" to the class as to why this species is important and what the students could do to remedy the habitat loss. Look for evidence that students understand food chains and the role of organisms in ecosystems.

2 Ask students to research other reasons why polar bears are threatened/endangered (toxic chemical pollution, oil exploration and over-hunting). Have pairs of students create posters identifying one of these reasons and what the effect is on the arctic sea ice ecosystem. The poster



Bearly Any Ice

should include a clear description of the threat to polar bear populations, how it will affect polar bears, as well as other organisms in the ecosystem.

- 3 Research and report on interactions between the First Nations people and other species of bears in British Columbia. The report should describe, using examples, of how the practices of Aboriginal peoples in BC affect environmental sustainability in a specific ecosystem.

Source

Adapted with permission from *Climate Change North: An Educational Resource for Northerners*.
http://www.climatechangenorth.ca/section-LP/LP_10_HI_M_peter.html

Originally adapted from *Project Wild*, Canadian Wildlife Federation, Ottawa, 1992.



Bearly Any Ice

Bearly Any Ice Data Chart

Season	Season duration (e.g., six runs)	# of Hula Hoops	# of Seals at beginning of season	# of Seals at end of season	# of Adult polar bears at beginning of season	# of Adult polar bears at end of season	# of Cubs at beginning of season	# of Cubs at end of season	# of Cubs born	(total # of seal player tokens)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										