



Arctic Survivor

LESSON

GRADE LEVEL 7-12

CATEGORY Energy,
Atmosphere & Climate

TOPIC Climate Change

TIME

- Warm-up: 10 – 60 minutes (research option dependent)
- Activity: 50 minutes, including debrief
- Wrap-up: 20 minutes for data analysis and discussion

SETTING

Large open space in gymnasium or outdoor playing area or classroom

MATERIALS

- Ropes or cones to mark boundaries
- To make the “Changes to Habitat” spinner:
 - Heavy cardboard
 - Large paper fastener
 - Spinning pointer
 - Spinner Copy Pages
 - Optional: Blank spinner template (Copy Pages)
- Polar Bear Population Chart (Copy Page)
- Clipboard and pencil (for Polar Bear Population Chart)

SUBJECT AREAS

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

KEYWORDS

Habitat, predator, prey, food chain, food web, population, climate change impact, adaptation, threatened, endangered, extinction, extirpation

Overview

In an active game, students role-play polar bears and the habitat components of food, water, shelter and space to understand how polar bear populations are affected by changes in their habitat. In the second part of the game, some possible impacts of climate change on the Arctic habitat of polar bears are explored.

Background

Polar bears live and hunt on sea ice throughout the arctic regions, including in Canada. The effect of climate change on their habitat is visible and alarming. Animals, including humans, in every region of the world will be affected by the climatic changes brought by rising global temperatures due to the enhanced greenhouse effect (see the Primer for more information on the greenhouse effect). Because the loss of polar bear habitat is so clearly evident and because of the general appeal of polar bears, this is a perfect opportunity to introduce students to the impacts of climate change on animals and their habitats.

All living things have basic needs that must be met to survive; for animals these include food, water, shelter, and space. The habitat of an animal provides these needs in an arrangement that is suitable for that particular species; the habitat is where an animal lives. The range of habitats available in an area or region is a result of the specific geography (e.g. latitude, elevation, and land or water), climatic conditions (e.g. average temperatures, precipitation patterns, amount of sunlight throughout the seasons) and presence of other species. Habitats vary greatly in size from a tiny pond to a vast ocean.

Populations of animals (a group of one species in a region) have adapted through evolution over thousands of years or more. The resulting adaptations enable individuals to meet their needs in their habitat (e.g. the ability to locate and obtain food and water; find and/or build shelter; establish a territory for space, etc.) and to survive the typical climatic conditions of their habitat (e.g. winter snow; drought conditions in summer, etc.). Often species can adapt to gradual changes in the physical and biological components of their habitat, but the current rapid rates of change due to climate change is beyond the ability of many species to adapt through evolution. Many species now face extirpation (loss of a population in a region) or total extinction.

The numbers of individuals in a population fluctuate naturally over time. Ideal conditions in habitats allow animals to have high survival rates and reproduce successfully. As a result, the size of their population will continually increase. This rarely happens because one or more habitat components (food, water, shelter, space) are usually only available in limited or fluctuating amounts during all or part of the year. Other limiting factors such as predation also can lower reproduction and survival rates, thus limiting population growth.

Food supply is a limiting factor for many animal populations and may have a subsequent effect on food chains and food webs within the ecosystem. For example, if the amount of grass seed is diminished due to poor growing conditions in spring, the size of a mouse population in the fall may not be as large as it is in good growth years because fewer mice were able to successfully raise offspring. The lower number of mice then limits the growth of predator populations such as owls and snakes.

The far-reaching impacts of climate change may be felt nowhere greater than in Canada's Arctic, one of the fastest warming regions on Earth. With winter temperatures anticipated to rise by 5 to 10°C during this century, northern habitats could experience huge climatic impacts such as increasing snowfall, eroding shorelines, melting permafrost, and warmer, deeper oceans.

The most dramatic impact may be the shrinking of the arctic sea ice. This frozen platform is integral to Earth's atmospheric and ocean circulation and energy distribution patterns. It also supports a wide range of species, such as polar bears, ringed seals, and walruses, that feed, travel, and breed on its vast expanses. Algae living under the sea ice are the foundation of an ocean food web that includes phytoplankton, copepods, fish, seabirds, and mammals. The average thickness of the sea ice has shrunk by 40 percent in the past three decades, jeopardizing the future of this web of life.

Polar bears, in particular, will be affected because changes to the sea ice will greatly decrease access to and the population size of its principal prey, ringed seals. Polar bears hunt ringed seals as the seals come up through their breathing holes in the sea ice. As the climate gets warmer, the sea ice could start to break up several weeks earlier in spring, reducing the length of time available to polar bears to hunt and fatten up before summer, when they usually fast. Unseasonable warmth could also cause the birthing lairs of ringed seals to collapse, reducing their pup's chances of survival and further limiting food for polar bears. As a consequence, mother bears will have more difficulty nursing

and successfully raising their cubs because of lower body weights. Biologists have already noticed a sharp decline in the birth rates of some polar bear populations and are concerned about the future of these animals.

Procedure

Set-up

1. Make a "Changes to Habitat Spinner" by copying or printing the Copy Page template and gluing it onto heavy cardboard. If available, add the spinning pointer to the center. If not, make a cardboard pointer and use a paper fastener or flat end bolt and nut to hold the pointer in place at the center of the spinner while allowing the pointer to spin.
2. Copy or print the "Polar Bear Population Chart" (see Copy Page) and attach it to a clipboard. Optional: Print two or three extra copies on hand in case the activity goes beyond 15 rounds.
3. Set up markers (ropes or cones) in a playing area so that there are two parallel lines on the ground or floor approximately 10 meters apart.

Warm Up

1. Begin by asking the students what basic things animals need to survive; list their responses. Explain the concept of animal's "habitat", helping the students to recognize that an animal's needs are met by their habitat. Introduce the four principal components of an animal's habitat: food, water, shelter, and space. Highlight the items on the list generated by the students that fall into each habitat component. Note: students may confuse the physical characteristics of Earth that support life (sunlight, water, soil or nutrients, and air) with the needs of animals to survive (food, water, shelter and space). Clarify if needed.
2. Ask pairs of students to choose an animal and identify its habitat. Encourage the students to ask questions and try to figure out how their animal meets its basic needs in its habitat (i.e., what are the animal's adaptations). For example, where do bats find shelter? How do garter snakes locate their prey? Why do birds have territories? (A: territories are an example of the "space" component of habitats). If time permits, allow them to use classroom books and/or computers to research answers, otherwise encourage best guesses. Have each pair to "present" their animal and its habitat. If there is limited time, have the students only provide one adaptation; otherwise encourage full presentations.

3. Tell your students they are about to take part in an activity about polar bears and their arctic habitat. Briefly describe the polar bear's habitat, explaining that they obtain food and water on sea ice, find shelter for dens in snowdrifts, and have large territories (space) that they move through over a year. Highlight adaptations that help make the polar bear particularly well suited to their habitat. (See Resources at the end of this lesson for more information on polar bears habitat, adaptations and climate change.)

Alternatively, ask the students to research the above information about polar bears and present their findings. Create a summary of all the findings under each habitat component category (food, water, shelter, space).

4. Now tell the students that the activity also is about how the polar bear's arctic habitat may no longer meet its needs due to climate change. Brainstorm what might be changing in the polar bears' arctic habitat and why. List some of the positive and negative effects of climate change on the polar bear's food, water, shelter and space.

For example:

- Less food because of shorter hunting season of primary prey, ringed seals, due to the early melting in spring and later formation of sea ice in autumn
- Less space as access to denning or summer resting areas is more difficult due to thinner, less extensive sea ice
- Less food as seal birthing lairs are often destroyed before the pup is able to forage on its own due to earlier break up of sea ice (declining population)
- More land based denning shelter for polar bears due to increasing snow fall
- More drinking water because of increasing precipitation and
- More abundant berries, grasses, and other plants (supplementary food for pregnant females) during the summer thanks to rising temperatures and longer growing seasons (could also result in greater numbers of reindeer, an alternate prey source).

Activity

1. Take your class to an outdoor playing area or a large, open indoor space and gather in a circle. Ask the students to count off from one to five. All the "fives" are the polar bears and the "ones", "twos", "threes", and "fours" are the polar bears' habitat components. **Assign each group a role** as follows:

- "ones" = food
- "twos" = water
- "threes" = shelter
- "fours" = space
- "fives" = polar bears

Inform the students that for the first set of rounds, they must play the role they have been assigned but in the next set of rounds they will be able to choose their role.

2. Explain that in order to survive, polar bears need to find food, water, shelter, and space. Using the following hand signs, habitat components indicate what they are and polar bears indicate what they need:

- food: clamp their hands over their stomachs
- water: hands over their mouths
- shelter: hands together over their heads
- space: hold arms out to the side.

Note: students often remember the hand signs better if they decide as a group what each habitat component action should be.

3. **Describe the activity.** To begin each round, the polar bears line up along one of the parallel lines while the habitat components line up along the other. The students should be approximately ten meters apart. At the start, both groups must face away from each other. For each round, the polar bears need to decide what component of their habitat they are in most need of at that time and make that hand signal. Habitat components also make their hand signs to indicate what they are.

At an established sign (e.g. whistle or call) both polar bears and habitat components turn to face each other, showing their signs. Habitat components stay along the line while the polar bears run to get the habitat component they need. Both groups need to hold their sign until all the bears obtain their needed habitat component.

Polar bears get to pick and pursue any one of their needs during each round of the activity. However, they cannot change what they are seeking during that round. If they survive, they can choose to meet the same need again or a different need in the following round.

4. **Before starting, record the total number of polar bears** on the Polar Bear Population Chart. Remind the students that they must remain as the habitat

component they were initially assigned throughout the first set of rounds; polar bears will choose what they need in each round before they turn around.

5. **Begin** the first round by asking all students to make their signs. Give the students a moment to get their hands in place and then give the signal for the play to begin.

If the polar bear obtains its required habitat component, it takes the “food,” “water,” “shelter,” or “space” back to the polar bear line. That habitat component now becomes a polar bear. This represents how the polar bear has successfully met its needs and has reproduced, resulting in an increase in the polar bear population. Any polar bear that fails to find food, water, shelter, or space dies and becomes a habitat component. If more than one polar bear reaches a habitat component, only the one that gets there first survives. A polar bear that has become a habitat component can now choose what hand signal to use (food, water, shelter or space).

6. **Record the number** of polar bears in the Polar Bear Population Chart at the end of each round. Complete at least five to ten more rounds and observe the polar bear population fluctuations for this first set of rounds.
7. In the second set of rounds, climate change begins to show its effects. Demonstrate for the entire class how the “Changes to Habitat” spinner works. Explain that only the habitat components will see the positive or negative impact that the spinner points to – polar bears will not know what will be happening to their habitat.

Before each spin of the “Changes to Habitat” spinner, students resume their assigned roles (either polar bears or habitat components) from the beginning of the activity. For each impact indicated by the spinner, the proportion of the habitat components will change. For example, if the spinner lands on a positive impact, such as more water, then all the students representing that increased habitat component will remain in that role (water) and the other habitat components may assume any role they wish, including water. If the spinner lands on a negative impact, such as less food, then the students who represent that decreased habitat component (food) may change to whatever component they wish and all the other students remain in their original assigned role. The result will be little or no food for the polar bears.

8. **Demonstrate a round** by spinning the “Changes to Habitat” spinner. Ask the students to figure out what habitat component each will play to model the impact.

It is suggested that the teacher or assistant stay at the habitat component line to help the students figure out what to do each round.

9. Once the students who are habitat components know what to do in each round based on what the spinner landed on, ask them to predict the outcome of that round, e.g. more polar bears will survive and reproduce because there is more shelter.

Continue the game for about 10 to 15 rounds, keeping the pace brisk – the students will enjoy it. Remember to record the data at the end of each round in the Polar Bear Population Chart.

10. Briefly debrief the impact after each round. Ask the habitat components if their predictions were met. Why or why not? Ask the polar bears, “What climate change impact do you think this round was about? How can you tell? How were the habitat components changed this round?”

Wrap Up

1. Use a flip chart or blackboard to post and/or graph the data recorded during the activity. Each round represents one year, thus the activity represents approximately 15, depending on the number of rounds played. See the example graph provided on page 7.
2. Explore the data with the students. Discuss the observed trends by asking such questions as: Why did the polar bear population increase? Decrease? How does this game represent the real world? (A: populations of organisms often fluctuate based on yearly conditions in the habitat.) How does it not represent the real world? (A: the rate and degree of change seen in activity is too dramatic; changes are more gradual in the real world. Also, there are an equal number of “positive” and “negative” effects and they have the same degree of impact in this activity; the concern is that the actual negative effects far outweigh any positive ones.)
3. What observed effects did the various climate change impacts have on the population of polar bears? Briefly introduce the concept of limiting factors on population growth, e.g. food. Discuss limiting factors in relation to polar bears. For example, how access to ringed seals, and the number of seals, is decreasing as the sea ice shrinks due to warmer temperatures. Decreased availability of prey may severely limit the growth of some polar bear populations in the future, leading to declining polar bears numbers.

Compare the results of this activity to what is actually happening in various polar bear populations in Canada, especially the southern populations (see Resources for more information). Introduce the terms threatened, endangered, and extinct.

Ask the students to predict how polar bears might adapt to their changing habitat (A: shift to alternate prey species where possible; individuals may increase the range of their territory in search of food.) What challenges do they face? (A: because they are long lived, and the time between generations is long, it is much more difficult for polar bear populations to adapt to rapid changes in their habitat.)

4. Discuss wildlife populations in your region that may be impacted by climate change. Consider local food chains and webs, for example the top predators (grizzly bears, cougars, salmon) and their prey (salmon/trout and berries, deer and small mammals, herring and zooplankton). Research the predicted changes in your regional climate and the impact this may have on wildlife. (See About Climate Change, LifeSmart BC, government of BC: [http:// www.livesmartbc.ca/about/index.html](http://www.livesmartbc.ca/about/index.html))
5. Ask the students if what they do in their daily lives affects polar bears (or the animals in their regions discussed above). Explore how human activities that produce greenhouse gas emissions influence global warming. Discuss what students can do individually or as a class to reduce their impact. (See lessons "Greenhouse Gas Game" and "Carbon Cycles" and the Primer for more information).

Assessment

1. Ask students to identify and compare the four main habitat components of two animals that live in quite different ecosystems (e.g. Orca and Western Rattlesnake). Students should be able to verbally explain how they are the same (habitats meet the basic needs of animals) and how they are different (the details of what each animals eats, where they rest and hide from predators, etc.).
2. Ask students to choose two bear species and compare their adaptations for the habitats they live in. For example, what enables polar bears to live in very cold temperatures compared to black bears? (A: Extra layer of skin and thick blubber and fur all help to insulate the body of the bear). Look for evidence that students understand the term adaptation, the concept that

populations of organisms, not individuals, adapt to environmental changes over time (individual animals can not choose to adapt), and the concept that adaptations allow the animals within a population to best meet their needs in their habitat.

3. Look for evidence that each student can interpret the class graph (produced from the tracking of the polar bear population through the activity) by asking them to make predictions about the impact of changes to habitat components. For example, "What might happen to polar bear populations if alternate prey species such as caribou become more accessible and abundant?"
4. Ask the students to write a story from the perspective of an individual polar bear in the situation that the current changes in sea ice habitat slow down or even reverse.

Extensions

1. In small groups, have students research other animals or plants and design a "Changes to Habitat" spinner for their species. Use the blank template Copy Page provided. Play the game again, using the students' new spinners.

Source

Adapted from Hinterland Who's Who, www.hww.ca. This activity is based, in part, on "Oh Deer!" from Project WILD.

Resources

The Climate Change Institute

www.climate.org/topics/climate-change/polar-bears-climate-change.html

World Wildlife Fund

www.ngo.grida.no/wwfap/polarbears/risk/index.html

Polar Bears International

www.polarbearsinternational.org/bear-facts/climatechange/

LifeSmart BC: About Climate Change

www.livesmartbc.ca/about/index.html

