



New Challenges in a New Climate

Age range: 16-18

Time: Two 75-minute periods

Subjects: Science, World Issues, Geography

Resources: Class set of handout:
New Changes in a New Climate

Learning Outcomes

Students will investigate the extensive adaptation of a chosen species found in Canada's boreal forest by conducting Internet and print research. Then, given a description of the future conditions that might exist in Canada due to global climate change, they will hypothesize about how the species they researched may be able to adapt in future, while recognizing the limitations of the activity in terms of evolutionary science (see Procedure).

Hook: Types of Adaptations

This hook will introduce students to the differences between structural, behavioural and physiological adaptations to various environments, so that they will be prepared to do a thorough job when presented with the main activity, which focuses on various species in the North American boreal forest.

Divide students into small groups, and have each group describe on paper as many adaptations (structural, behavioural, physiological) as possible for some or all of the following organisms (possible answers provided below). Share results. Go over the difference between the types of adaptations.

Cactus – Desert

Structural: thick and waxy coating prevents moisture loss, shallow and widespread roots to absorb scarce rain, spines to protect them from being eaten

Physiological: slow growing, ceases transpiration during hot part of the day

Camel – Desert

Structural: special eyelids protect them from sandstorms, light coat colour keeps them cool, wide-spread feet for walking on sand

Physiological: storage of water in fat found in the hump

Behavioural: rests during hottest part of day

Seal – Shorelines, Cold Water

Physiological: large fat stores, excretion of oil into coat to prevent cold water from reaching skin, ability to hold breath a long time

Structural: nose closure when diving, flippers and tail for agile swimming

Behavioural: various hunting techniques, some migrate to follow food sources, bradycardia (slowed heart rate during diving)

Procedure

1 Go over Handout *New Changes in a New Climate* and assign (or have students choose) boreal species to research (in pairs or individually).

2 Discuss with students that because natural selection is a very slow process, the climate in Canada's boreal forest may change too fast to allow any large organisms to evolve structural or physiological adaptations that will help them to survive. This means that some of the species that make up the present day boreal forest (animals, trees, other plants) may have difficulty surviving if the climate changes too dramatically, and too quickly, in an evolutionary sense. However, others will survive and even thrive. These changes in the composition of all species and in the abundance of specific species are known as **ecosystem level adaptation**.

Large mammals and birds would likely show mainly behavioural adaptations (not adaptations in the evolutionary sense) to the conditions caused by climate change that are anticipated in the next century or so. The vast majority of organisms that we might expect to truly evolve adaptations in this timeframe are those with short lifecycles and high intrinsic variability, such as insects, bacteria and viruses. (Intrinsic variability means that there is considerable variability in traits between members of the same species.) However, for the sake of this exercise, we will pretend that boreal animals and birds are able to quickly evolve adaptations (over many hundreds of imaginary generations) to new conditions being brought on by global warming.

3 Next, introduce the boreal forest using maps from pages 4 and 5 and the Hinterland Who's Who handout found at: <http://www.hww.ca/hww2.asp?id=354>. See the Teaching Resources section in teaching kit Volume 7 for more options.

4 As outlined on the handout, students will research their species, read the description of how conditions could change in Canada's boreal forest due to global climate change, and hypothesize on how their species could adapt behaviourally, and which physiological and structural adaptations they might evolve. (That is, which changes in physiological processes or in body structure would give members of the species possessing these differences an 'edge' over others, making them more likely to survive and reproduce, passing on genes relating to favourable traits.) Students may present their work to the class.

Extension

Have a class discussion, or have students write a summary paragraph, reflecting on how climate change may allow some species to thrive and how it might affect others negatively.

Example Answer

1. Black bear
2. Habitat – in summer, forests and riparian areas; in winter, hibernates in the northern part of its range (Canada).
3. **Physiological:** true hibernation (recycling of urine, lowering of metabolic rate, long-term unconsciousness), produce small number of young well-spaced in time, regulates body temperature in hot and cold temperatures
Behavioural: various hunting techniques (digging, scavenging, roaming, swimming), hibernates, stands upright to view habitat and reach for food, takes snacks into den for winter
Structural: thick coat protects hibernating bear from cold, large deposits of fat allow bear to survive hibernation, long claws for digging up insects, etc., large muscles for pushing aside rocks and stumps, long snout to sniff out food, excellent eyesight and hearing, tough paw pads for walking over rough terrain
5. Due to Climate Change:
Behavioural: will eat more of the beetles and other insects that will flourish due to climate change, will most likely have shorter or no hibernation (similar to present day members of the species found in the southern part of its range), eating of plants and other organisms that flourish after forest fires
Structural: thinner coat so animal does not overheat
Physiological: ability to resist diseases that may result from global warming, more young, shorter or no hibernation

Name: _____ Date: _____



New Changes in a New Climate

1. **Choose a boreal species to research:** woodland caribou, snowshoe hare, dragonfly, beaver, river otter, lynx, gray wolf, black bear, Sharp-shinned Hawk, spruce budworm, Bufflehead duck, lemming, eastern garter snake, tamarack, snapping turtle, wood bison, moose, black spruce, white admiral butterfly, little brown bat, blue spotted salamander, wood frog, mosquito, blackfly, mountain pine beetle, carpenter ant, Pileated woodpecker, Ruffed grouse, Osprey, Northern hawk owl, cricket, hornet etc.
Use website searches to sites like www.hww.ca, and encyclopedias for your research.

2. **Describe the habitat(s) and climate** to which this species is adapted (in all seasons):

Winter: _____

Spring: _____

Summer: _____

Fall: _____

3. **Present day adaptations to the habitat and climate** (consider how the animal is adapted to travel, find food, store food, eat, grasp things, find a mate, reproduce, handle temperature extremes and other seasonal factors, sense its environment and avoid being eaten or attacked, etc.)

Physiological adaptations (four or more): _____

Behavioural adaptations (four or more): _____

Structural adaptations (four or more): _____



4. Read the following description of how scientists believe climate change will affect Canada's boreal forest:



With increased carbon dioxide and warmer, wetter weather, the boreal forest will most likely become more productive. Diseases such as West Nile Virus and Lyme disease will become much more common.

At the same time, there could be more drought in drier regions due to the warmer temperatures that drive evaporation from lakes, soils and vegetation. Forest fires will most likely increase in frequency, intensity and severity. The mountain pine beetle, which has decimated the lodgepole pine species in British Columbia and in some areas of Alberta, could continue its spread eastward. Because of this, other tree species, such as aspen or white spruce, could become more common. The forest will slowly shift northward into areas that are presently tundra. At the southern edge, hardwood forests will likely expand, bringing species such as oak, maple and beech into areas once occupied by the boreal forest. In drier regions, the forest may give way to grasslands (similar to those that once covered the southern portions of the Prairie Provinces).

5. From the description above, what conditions will affect your species? _____

6. Hypothesize how your chosen species could evolve and adapt to these conditions:

Four behavioural adaptations: (Reminder: These are the most likely adaptations you would expect to see in birds and animals in the next century or so, as global warming continues to affect Canada's boreal forest): _____

Four eventual possible physiological adaptations: _____

Four eventual possible structural adaptations: _____

