



Maple Trees and Marmots

LESSON

GRADE LEVEL K-3

CATEGORY Energy,
Atmosphere & Climate

TOPIC Climate change

LENGTH

20 minutes

MATERIALS

Grades: K-2:

- Tokens to represent food (5 per student)
- Blankets or coats to represent snow /hibernation den (one blanket/two students or one coat/student)

Grade 3:

- Colored tokens to represent Sun, Air, and Water ecosystem components. Use one colour per component (5 of each component per student)
- Blankets or coats to represent sugars (one blanket/two students or one coat/student)

SETTING

Gymnasium or outdoors

GROUP SIZE

20+

SUBJECTS

Biology, Ecology, Science,
Language Arts, Art

Overview

This activity explores the effects of climate change on animals and plants through role-play games. For non-coastal regions, the activity can be about Aspens and Ground Squirrels. In order to meet the prescribed learning outcomes, this activity is in two parts. The first activity section covers Grades K - 2 and focuses on animals. The second activity section covers Grade 3 and is about plants. All grades can conduct the seed experiments to show the simple effects of increased/decreased precipitation and temperature on plants (see extension at end of Grade 3 section for details).

Objectives

Students will:

- Describe features of local animals
- Describe the basic needs of local plants and animals
- Describe how the basic needs of plants and animals are met in their environment
- Infer the probable outcome of an event based on observations
- Describe some changes that affect animals
- Describe ways in which plants are important to other living things and the environment

Making Connections

Climate change is already bringing change to British Columbia's natural environment. Seasonal changes are having enormous effects on forests, river temperatures and peak wildflower blooming times. Living in urban areas, as most British Columbians do, these changes can go unnoticed and thus unmitigated. It is important for everyone to gain an understanding of the changes climate change may bring. This activity allows students to gain insight into how climate change may affect familiar plants and animals.

Background

Climate change affects plants and animals both directly and indirectly. Changing climatic factors such as the level of precipitation, seasonal timing, cooler or warmer temperatures, etc affect plants and animals directly whereas potential disruption to carefully timed flower and pollinator cycles, plant growth and herbivore behavior affect them indirectly. The effects of climate change on plants and animals will be most dramatic in environments such as transition zones between ecosystems and alpine areas.

For alpine animals, such as marmots and ground squirrels, winter means hibernation in underground burrows in a state of torpor where body temperatures drop to the same as the air around them. Metabolisms are lowered to match this and the stored body fat is slowly used for energy over the entire winter. Snow cover over the underground den provides a layer of insulation making temperatures in the den constant. The spring and summer months are spent 'fattening' up on plants and seeds for the winter hibernation.

For plants that can not move to more favourable climates, climate change may mean plants have to adapt or endure changes in precipitation, sunshine levels, increased pests (e.g. mountain pine beetle), or changes in pollinator timing. These increased stressors may affect overall vigor and or seed quality and production. For some trees, especially in northern treeless areas, climate change may mean increased habitat as colder tundra areas give way to more forest favorable condition; dry conditions on the coast may mean reduction in Western Hemlock vigor, a wet and shade loving tree.

Procedure

Grades: K–2

Warm Up

1. Explain to students that animals (including humans) have a 'metabolism', which is the rate at which a body uses its energy. Everything an animal eats is turned into energy to be used to keep it warm or to do things (such as grow, move, and think).
2. Have the class perform jumping jacks or skip rope until they have an increased heart rate, feel warmer and are breathing heavily. This activity demonstrates that increased activity means more warmth. An increase in metabolism can be measured by the rate of respiration (breathing out). Animals use muscles to move and these muscles require energy; energy that comes from the food that is eaten.

3. Discuss with students that winter is a hard time for animals to find food, especially in mountain areas where snow covers the ground during the winter and the plants are not growing. Some animals hibernate through this difficult time. These animals spend the spring and summer fattening up on growing plants. When animals hibernate we think of them as sleeping, but really the animal has the ability to lower its activity level metabolism so that they do not need to 'burn' as much energy (stored as fat) to stay warm. During hibernation an animal's body temperature is the same as the air around it so they do not feel cold or need to create warmth. Just as was demonstrated with the jumping-jacks above, when inside a heated building, we do not need to keep moving to stay warm, the building air is warm already, so our metabolisms are not working as hard to keep us warm. For an animal in a hibernation den, a constant cool air temperature means a lower body temperature and thus a lower metabolism and less energy (stored as fat) being used.

The Activity

1. Define a large playing area and spread the food tokens out widely.
2. Explain that they are going to pretend to be Vancouver Island marmots or ground squirrels and go through a few years of spring, summer, fall, and winter. Their challenge will be to collect enough food to survive the winter.
3. Students take their places in their dens. They must drape their coat or blanket over them to simulate a blanket of insulating snow over the den. The game starts in the spring. The Leader calls out, "Spring", and the hibernating animals awake and begin to move about finding the tokens they need to survive. Allow the fastest students to collect about six tokens.
4. The Leader calls out, "Summer", and students continue to collect tokens. When the Leader calls out, "Fall", the students should stop collecting tokens and get ready for winter by returning to their shelter site. When the leader calls out "Winter", the animals get onto their shelter site and begin to hibernate. Students show they are hibernating by stopping movement and settling in at their den site.
5. The animals should remain as still as possible. Every minute is equal to one month and each month uses two tokens of food (in real life this would be the animals stored fat). The snow and the depth of the den keep the temperature constant so the animals should not too get cold or too hot and thus their body fat should last the winter. If possible, hibernate for three months (three minutes).



6. After one minute, the Leader calls, 'One month of winter has passed, spring is two months away.' Each animal must present two food tokens for the Leader who comes around to collect them. After the next minute has passed, the Leader says, "Two months of winter have passed, spring is one month away." Students again have to give up two food tokens. If in the second month all their food is used up, the animal must awaken, due to hunger and help with the rest of the winter by collecting tokens. After the third minute (third month) the Leader calls, "Spring is here!" All animals with food left over may wake up and start gathering more food."
7. The Leader scatters the collected tokens around the play area. The animals that ran out of food during hibernation may collect more food tokens in the second round. If any animals have food tokens left over from the first round, they may keep the food for next year and collect tokens again. Let them collect as much as they think they are going to need for the hibernation.
8. During the second hibernation round, introduce a new situation. There has been a milder winter that has reduced the amount of snow that covers the animal's dens. Some of the dens have only a very thin dusting. The den temperature will not be as constant and the animal will burn more food to survive winter hibernation. Each month of hibernation now needs three tokens. Play as in round one above but collect three tokens each month.
9. Allow the animals to collect food again for a third season and go through hibernation again until the students understand what a warmer winter with less snow might mean to the animals: uncertainty.

Wrap Up

The marmots or ground squirrels must eat enough extra food during the spring and summer to survive the winter as well. This means they have to find a lot of food, which is not always easy to do. When they get older, they have to store enough food to have and nurse their babies. Any changes in seasonal cycles of plant growth and snowfall can have serious effects and animals have to adapt. One of the effects of climate change is change in seasonal cycles. If the change comes quickly or dramatically, animals may not have time to adapt and gather enough food.

Assessment

Have students create an illustration of a marmot or ground squirrel gathering food and another illustration that shows it hibernating deep in a den with a nice thick covering of snow on top to keep it warm.

Grade 3

Warm Up

1. Explain to students how plants make food (sugars and starches) during photosynthesis.
2. Discuss with students how plants are different from animals. Plants use their leaves to create food through photosynthesis; water is essential for this and plants bring up water from their roots to their leaves to grow bigger and to create food through photosynthesis. Discuss the following questions: What do some trees do during the fall to prepare for winter? What sort of light is available during the winter? Why do plants lose their leaves during winter?
3. Explain that maple trees and other broad-leaved trees not only drop their large leaves but they also concentrate sugars to help the twigs of branches survive the winter. A high concentration of sugar does not freeze quickly and thus the tree is not subjected to the damaging effects of ice. You may wish to perform a simple experiment by preparing two sugar syrup solutions; one with a high concentration of sugar and one with a low concentration of sugar. Place them in a freezer first thing in the morning and then check them every hour. Time how long it takes each of them to freeze and compare the times. You may also wish to explore how water expands when it freezes which would damage the twigs and leaves of trees. Freeze and then thaw some leaves or a small plant to demonstrate the damage freezing can do.

The Activity

1. Everyone is a maple tree or aspen. They have to collect water, sun and air tokens to create, through photosynthesis, enough carbohydrates (sugars and starches) to survive the winter. Explain that because they are not actually trees and cannot create their own food with leaves, they are going to pretend for this game that trees can move.
2. Define a large playing area and spread the air, water, and sun tokens out widely. Students should pick a home 'rooting' point to come back to during the winter and place their coats there. For this activity, students will pretend that their coats are like the sugars a tree uses in the winter to protect its branches and twigs from freezing.
3. The trees will start at their rooting point and run or walk to find tokens. There are a limited number and they have to collect a varied selection. They should collect as many sets of three different colored tokens as possible. Students may trade with each other if they wish.



4. When the Leader calls, "Spring", the game will start and the trees may move about to collect the tokens. They may continue to collect tokens when the Leader calls, "Summer", but when the Leader calls, "Fall", they must get back to their rooting point. There they will start making sugars - symbolized by dropping their collected tokens to their feet in front of them and putting on their coat or getting under their blanket. They should put their leaves (hands) in their pockets to show that they have dropped their leaves for the winter. By the time the Leader calls, "Winter" the trees should be dormant. They must stay absolutely still.
5. Every minute of winter is equal to one month and each time a maple tree or aspen moves during winter a sugar (three token set) is used up. The trees should stay still and dormant for three minutes. The Leader watches over the trees and collects a set of sugars from any that move during the winter.
6. After three minutes, the Leader calls out, "Spring". The trees open up their leaves and look at number of 'sugars' (numbers of combined tokens) they have left. If the tree has three sugars (three combined token sets), it has survived the winter and can move about to collect again. If students have more than three, they grow bigger and can keep the extra sugar combinations for next year. If the students have less than three sugars, they have to jump or hop on one leg while collecting their tokens. This represents a maple tree or aspen that was damaged by the winter weather. These trees cannot make as much food and consequently will not be able to produce many seeds this year. The Leader scatters any collected tokens back into the play area. Play a second round as above but with the modifications for stronger and weaker trees.
7. For the third round, the Leader tells the students that due to increases in carbon dioxide, a gas in the air, the earth's climate has changed and this year there is a water shortage (less rainfall). Play the game again but do not return any collected tokens to the play area.

Wrap Up

Discuss what happened in the third round. Not every maple tree or aspen made enough sugar to survive well. Can trees live with less sugar? What happens if the tree has less sugar and as a result its leaves are smaller? Will the tree be able to make sugar as well as it did with larger leaves? Will a tree with less sugar energy be able to make very many seeds? What might this mean for next year? What does that mean for animals that eat maple or aspen tree seeds?

What about bees and other insects that pollinate flowers in order for plants to make a fruit or seed? If climate change effects the timing of bees and other insect and animal hibernation or migration patterns, what might happen to plants that depend on these pollinators for their flowers?

Assessment

Have students explain, in their own words, how less water might affect the ability of a tree to produce seeds.

Extensions

1. Make sure students understand that maple or aspen tree in this game is a model for all types of plants. Can they think of some other ways that climate change may effect plants? How could they modify the game to reflect those changes.
2. Conduct a seed experiment with loose-leaf lettuce seeds. Vary the amount of sunlight and/or water that individual plants receive. Compare how they develop as they grow. When there are a few leaves large enough to sample, taste them. How does the one that had little water taste compared to the one with ample water? The less watered lettuce leaf should be bitter. Ask students why this would be the case (less sugar in the leaves). What other ways may water restrict plants such as trees?
3. Sometimes plants reproduce by producing a flower and then a berry or seed. Is a plant without water likely to grow a big flower and then a large seed or berry? What about the animal that depends on that berry or seed. Have students research animals that depend on plants that produce berries or seeds for their food.

