

# THE SUCCESSION RACE



**Grade Level:** 5-8

**Alaska State Content Standards:** SA12, SA14

**Subject:** Science

**Skills:** Analysis, Description, Generalization

**Duration:** 1 class period

**Group Size:** whole group

**Setting:** indoors or outdoors, large playing area

**Vocabulary:** succession, successional stage, herb stage, shrub stage, young forest stage, mature forest stage, maturing aging forest stage, habitat, minerals, vegetation mosaic

## OBJECTIVE

Students will list the factors that affect succession in a boreal forest.

## TEACHING STRATEGY

Through a game, students portray plants progressing through the boreal forest succession, affected by agents of change.

## MATERIALS

- Butcher paper
- Succession Cards
- Succession of the Boreal Forest After Fire

## TEACHER BACKGROUND

**Succession** is the natural, orderly change in plant and animal communities

that occurs over time. The successional timeline has been divided into stages that portray the slow, continuous changes in an environment. When an existing environment is disturbed by fire, insects, development, resource extraction, flood, or extreme weather, it generally reverts to an earlier successional stage. Herbs and shrubs dominate the earliest stages of succession. Intermediate stages follow, dominated by tall shrubs and young trees. Finally, a mature forest stage and a climax forest stage may follow. The pace of succession may be affected by soil conditions, climate, permafrost, topography, and natural forces.

Some agents of dramatic change in the boreal forest are:

- Insect invasion
- Bark beetle attack
- Flood and/or ice jams
- Land slides
- Too many moose
- Very hot, slow fire
- A fast fire
- Person building a house
- Development or roads
- Clearcut logging

Many stages of succession may be represented in a relatively small area. For instance, you may be walking through a dark, thick forest and come upon a clearing or meadow. Some agent of change affected that particular part of the forest, perhaps insect, disease or a small fire, and killed all of the mature trees. As you continue your walk you may come upon a thicket of bushes. This part of the forest is now in the shrub stage and may have, at one time, been a meadow and before that a mature forest. This patterning of various successional stages containing different plants is called a **vegetation mosaic**. Because fire can jump from place to place within a forest or may burn at different times and different intensities in various parts of the forest, fire is often the cause of vegetative mosaics.

Each species of plant has particular **habitat** requirements. These habitat requirements include specific amounts of light, heat, soil nutrients, and water. As a particular site progresses through successional change, tall plants create shade. Layers of moss insulate the soil and cause a drop in soil temperatures. More and more **minerals** become tied up in living and dead plant material. These changes in the physical

environment change the suitability of each site for different plant species. The kinds and numbers of plants present change as the physical conditions of the environment change. As each part of the forest changes, the vegetation mosaics change.

Like plants, wildlife species also have specific habitat requirements. Each species of animal needs the right kinds and amounts of food, water, cover, and space. Therefore, wildlife populations change in response to successional change.



The process of succession strongly affects wildlife use of the boreal forest. Some wildlife, such as white-crowned sparrows, fulfill their habitat needs in the shrub thickets of early forest succession stages. Others, such as white-winged crossbills, need large expanses of climax stage spruce forests to survive. Many boreal forest wildlife need a mixture of forest ages to meet their habitat needs. Snowshoe hares are a good example. Young willow and birch shrubs, which flourish in the early stages of succession, provide the food

snowshoe hares need. In winter, hares need the shelter provided by spruce forests.

The variety and abundance of wildlife in the boreal forest is largely a result of the habitat diversity provided by the vegetation mosaic. The complex and constantly changing boreal forest mosaic is created and maintained by the continual pace of succession.

Succession progresses in the tundra as it does in the boreal forest, although it is not as clearly understood and is extremely slow in comparison. Early succession is visible where lake levels have lowered and plants grow on the newly drained soil. Cottongrass tussocks take a long time to establish and don't grow in recently disturbed sites; if cottongrass is evident, then the area is probably in the later successional stages. Trees or shrubs with thick, gnarled, lichen covered stems are found in the later successional stages as well. Because little research has been done regarding tundra succession, less is known about its effects on plant and animal communities.

### **ADVANCED PREPARATION**

1. Copy and cut the Succession Cards making one set per student. Note that each stage is represented by a different color.
2. Make 5 large signs labeled "Herb Stage", "Shrub Stage", "Young Forest Stage", "Mature Forest Stage," and "Climax Forest Stage." These signs may be color-coded to match the Succession Cards.

### **PROCEDURE**

1. Before beginning the game share the information about succession with your students as found in the Teacher Background section. Review the five succession stages with the class. Brainstorm with students some of the factors that could affect the progression of succession to the "Mature Aging Stage."
2. Set up the playing field. Mark 5 lines across a field or other large playing area, with approximately 20 feet between each line (this distance could be smaller for small groups). Place the "Herb Stage" sign at one end of the field; the other end is labeled the "Climax Forest Stage." Place the remaining signs for the "Shrub Stage," "Young Forest Stage," and "Mature Forest Stage" in the remaining sections according to the diagram above. The color-coded Succession Cards are placed (face down and scattered the width of the field) in their appropriate stage areas; no cards will be placed in the "Herb Stage." There will be more cards at the "Shrub Stage" and "Young Forest Stage" than at the "Climax Forest Stage."
3. Students line up at the "Herb Stage" to begin the game. Explain to them that they are plants in various successional stages of the boreal forest. Their goal, as a forest, is to reach the "Mature Aging Stage."
4. The teacher starts the game by calling "Start Succession!". Everybody runs from the "Herb Stage" to the "Shrub Stage" where they each pick up a card and read it. The teacher should emphasize the importance of reading the cards since information contained on them

will be discussed later. The cards at each stage will give students information about succession. They will instruct students to proceed to the next successional stage or to start over at the “Herb Stage”. Students returning to the “Herb Stage” must put all their cards back (face down) in the color-coded stages before starting again.

5. As the game progresses the students should spread out over the stages of succession. The game ends when the first person reaches the “Climax Forest Stage” and calls out “Stop Succession!” Everybody must stay where they are. The first person over the line should have 4 cards. If that student does not have 4 cards, he/she puts the cards face down at the correct stages, starts over at the “Herb Stage”, and the game continues. If they do have all 4 cards, it is time to have a hot crown fire burn the area and kill all the trees of the young forest and the mature aging forest. All the trees at these stages return to the herb stage.
6. At the end of the game count how many plants are in each stage of succession. Discuss the following:
  - a) Why don’t all the plants reach the “Mature Aging Stage”? Why is this important?
  - b) What are some of the things (agents of change) which can cause succession?
  - c) How is this like and not like real succession in the boreal forest?
  - d) Is succession important? Why or why not?
  - e) Does succession happen to a plant or a forest? Explain.
7. Continue the game until all the cards have been used and no student can

move. Give each student paper and pencil. Ask all to write how forests might be affected by disturbances such as insects, flood, fire, logging, etc. and the advantages or disadvantages of an area returning to an earlier stage of growth. Discuss ideas and answers.

## **VARIATIONS**

The teacher may stop the game at regular intervals to allow students time to look around and see how the number of plants at each stage changes. A graph could be kept on the blackboard or a large pad to record the changes.

Stop the game when there are students in each of the stages. Discuss the benefits of a variety of habitat stages (vegetation mosaics). Think of ways both wildlife and humans could use each stage. How would wildlife and humans be affected if the trees were in just one stage? Could fire help maintain a wide diversity of plants and animals?

Stop the game and tell all the students to put their cards back in the stages and return to the “Herb Stage”. Ask the students what might have happened to cause the entire forest to return to the “Herb Stage.”

## **EVALUATION**

Have each student list at list 10 things that could cause the progress of succession to revert to an earlier stage.

## SUCCESSION CARDS - SHRUB STAGE

Directions: Copy on GREEN paper. Make one copy for every 5 students.

A snow machine runs throughout your portion of the forest forcing you to return to the herb stage.

There is abundant sun and water, allowing you to reach the young forest stage.

Fire burns you and you must return to the herb stage.

There are so many porcupines eating your shrubs that you must return to the herb stage.

A disease kills shrubs and you return to the herb stage.

There is not enough sunlight to grow, so you return to the herb stage.

A flood kills shrubs and you return to the herb stage.

The hare population decreases and you grow, reaching the young forest stage.

There are so many moose eating the stems of your young shrubs that you must return to the herb stage.

The moose population decreases and you grow, reaching the young forest stage.

The permafrost has thawed causing a landslide that takes the organic layer and vegetation away. You return to the herb stage.

There is abundant sun and water, allowing you to reach the young forest stage.

## SUCCESSION CARDS – YOUNG FOREST STAGE

Directions: Copy on BLUE paper. Make one copy for every 5 students.

A snow machine runs throughout your portion of the forest forcing you to return to the herb stage.

Moose population very high and they are eating all of the young trees. You remain in the young forest stage.

Fire burns you and you must return to the herb stage.

The porcupines are so thick that they are eating all of the young trees. You must return to the herb stage.

A disease kills trees and you return to the herb stage.

There is not enough sunlight to grow, so you return to the herb stage.

A wind storm blows down your trees, returning you to the herb stage.

There is unusually sunny, warm weather so you grow to the mature forest stage.

Landslide! You go back to the herb stage.

The moose population decreases and you grow, reaching the mature forest stage.

You have been able to get so much more sun, water and nutrients you are able to go to the mature forest stage.

## SUCCESSION CARDS – MATURE FOREST STAGE

Directions: Copy on YELLOW paper. Make one copy for every 5 students.

The land is cleared by humans, you return to the herb stage.

Your trees are chopped down for firewood, returning you to the herb stage.

A very hot fire burns you back to the herb stage.

A beetle outbreak kills your trees, returning you to the herb stage.

A disease kills trees and you return to the herb stage.

Loggers leave, allowing you to grow to the mature aging forest stage.

Landslide! You go back to the herb stage.

There is a warm summer and plenty of snow for water and you grow to the mature aging forest stage.

You have been able to get so much more sun, water and nutrients you are able to go to the mature aging forest stage.

You have been able to get so much more sun, water and nutrients you are able to go to the mature forest stage.

## SUCCESSION CARDS – CLIMAX FOREST STAGE

Directions: Copy on RED paper. Make one copy for every 5 students.

Land is cleared by humans, you return to the herb stage.

There is a warm summer and plenty of snow for water; you stay in the mature aging forest stage.

Very hot fire returns you to the herb stage.

Your trees are chopped down for firewood, returning you to the herb stage.

Beetles attack another tree, returning you to the herb stage.






A beetle outbreak kills your trees, returning you to the herb stage.

You have been able to get so much more sun, water and nutrients you are able to stay in the mature aging forest stage.



## Succession of the Boreal Forest After Fire

## Student Handout

 <p>Kathy Sarns</p>				
<p><b>Herb Stage (0-5 years)</b> Fire has burned the forest, returning minerals to the soil in the form of ash. Herbs (wildflowers, grasses, sedges) may grow from seeds and sprout from roots. Mosses and lichens may revegetate as well. In addition, seeds from outside the area may be brought in by wind or animals. Shrub seedlings often sprout from unburned roots, and many trees sprout from stumps. If the fire occurred in a mature or over-mature forest, dead trees called snags may still be standing.</p>	<p><b>Shrub Stage (6-25 years)</b> Shrub and tree seedlings grow larger and begin shading the grasses and other small plants. Shrubs and tree seedlings offer good cover for many animals such as birds, mice, and snowshoe hares. Foods for wildlife, including berries, seeds, buds, and leaves are plentiful. Tree snags that have fallen are decaying.</p>	<p><b>Young Forest Stage (26-50 years)</b> Sapling trees such as birch, aspen, and poplar (all hardwoods) have grown too tall for their leaves to be eaten by most animals. The forest canopy has become more dense, shading the forest floor. Only shrubs, herbs, and mosses that are shade-tolerant can grow under low light conditions found in this stage. Spruce begin growing among the hardwoods; however, their growth is slow. Most tree snags have fallen.</p>	<p><b>Mature Forest Stage (51-150 years)</b> Mature hardwood trees become less abundant as some die, opening the canopy for spruce to grow taller. Hardwood saplings, tall shrubs, herbs, mosses, and lichens also grow in the canopy openings.</p>	<p><b>Climax Forest Stage (150-300 years)</b> The canopy is more open. The forest is mostly spruce trees. Hardwoods, tall shrubs, herbs, mosses, and lichens grow in the openings. There are dying and dead trees still standing which provide food and cover for some animals.</p> <p>Boreal forest succession depends on soil, climate, water, and the presence or absence of permafrost. For example, in cold climates where there is permafrost and little rainfall or snow, succession may not progress beyond the shrub stage. Only dwarf trees and shrubs can grow in such environments.</p>