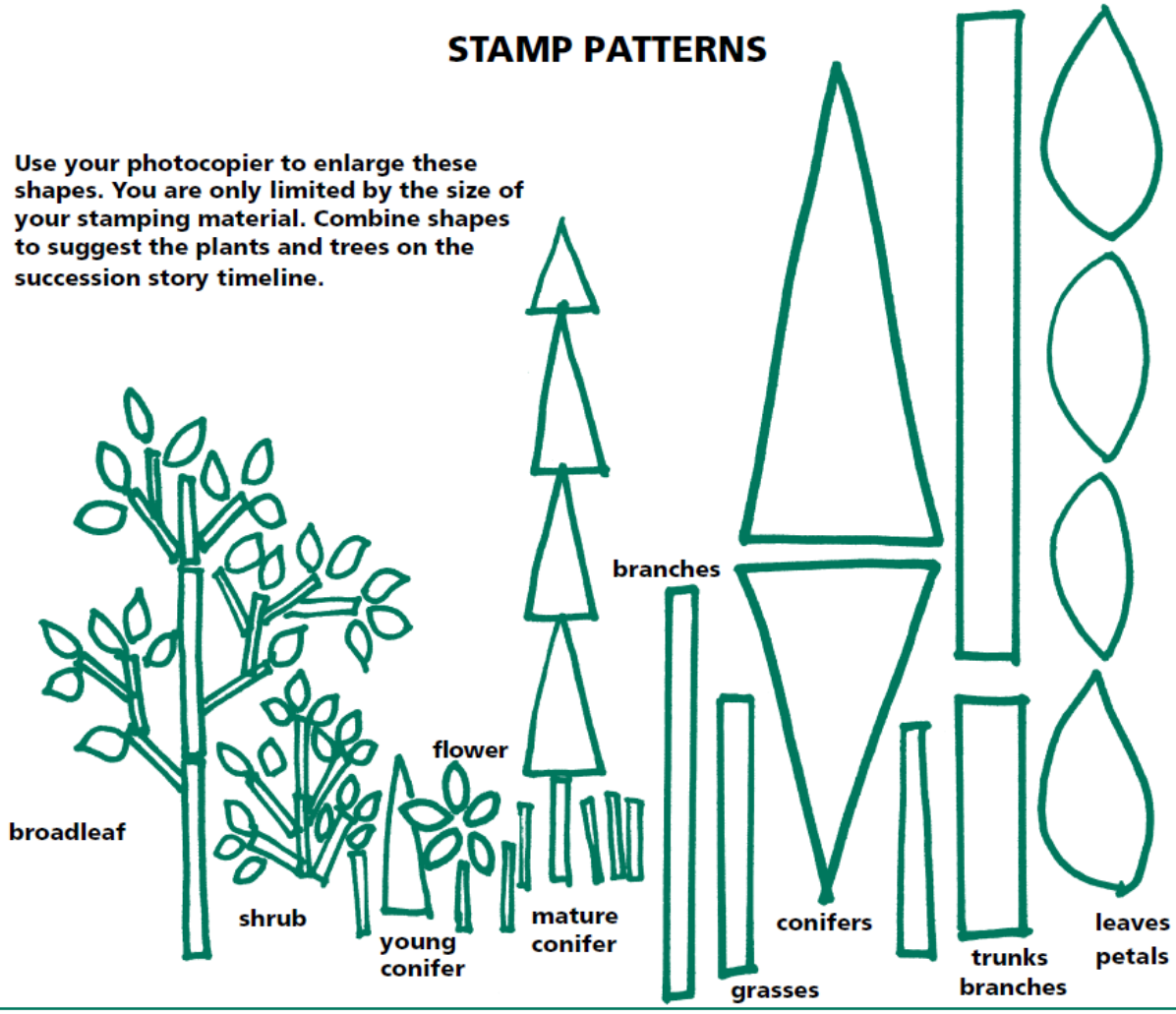
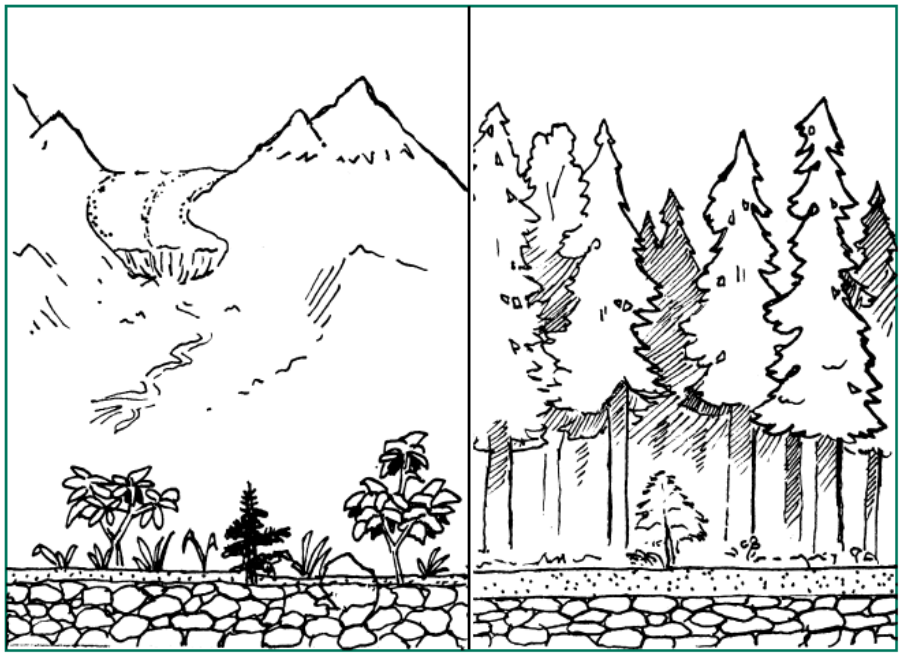
## STAMP PATTERNS

Use your photocopier to enlarge these shapes. You are only limited by the size of your stamping material. Combine shapes to suggest the plants and trees on the succession story timeline.



# The Succession Story

## 2 EXTENSIONS



*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 2 - 4

**State Standards:** LA B-1

**NGSS:** 2-ESS1-1.

**Subjects:** Science, art, language arts

**Skills:** Writing, listening, visualizing, observing, drawing, comparing

**Duration:** Five 20-minute sessions

**Group Size:** Whole class, individuals

**Setting:** Indoors

**Vocabulary:** Pioneer plants, primary succession, timeline

### Objectives:
Students will illustrate and write about the process of forest succession.

### Teaching Strategy:
Students visualize 1,000 years in the history of a forest and craft a timeline to portray the changes.

### Complementary Activities:
*INDOOR:* "Change in Our Lives" *and* "Animal Adaptations for Succession," *both in this section.*

### Materials:
Stamps made from sponges, potatoes, or self-adhesive insulating camper tape; water-based paint or stamp pads; crayons or markers; light blue or white butcher paper cut into 5 sections.

### Background:
**See INSIGHTS, *Section 4, Succession.***

### Procedure:
***(NOTE: For older students**, the following steps can be combined into one or two 30-45 minute classes.)*

1. Prepare stamps, paints, paper. Divide the mural into five sections: Pioneer, Shrub, Young Forest, Mature Forest, Old-Growth Forest.

2. Explain that forests change over a long, long period of time. Tell students that they will mimic that length of time by creating a forest over the course of the week.

3. To set the scene, you may wish to show parts of the video, "Glacier Bay" or "Voices from the Ice" or similar videos.

4. Students prepare for the guided imagery by setting aside all their pens, books, and papers. Students sit or lie down in a relaxed position with their eyes closed.

5. Before you start to read, ask the students to imagine themselves in the story and think about what they are "seeing" as they listen to each part. Set the scene for the mural by dramatically telling the story on the following pages. Speak slowly, allowing students time to create mental images.

6. The years are noted only for your reference for the mural **timeline**. The story is based on the **primary succession** pattern of growth in the coastal forest.

7. When each section of the guided imagery is finished, talk about the images the students created in their minds. List the key words as they verbalize them. That will be the basis for their illustrations and writing.

8. In each section of the mural, students with the appropriate stamps put their patterns on the **succession timeline**. The order of placement is (a) grass and flowers, (b) shrubs, (c) young forest, (d) mature forest. From the story include animals that live in the forest during different stages in succession.

9. After each section of the mural is created, ask students to compare the differences and similarities between stages. Ask students what happened to plants that died during the progression. *(They become soil and nutrients for future plants.)*

10. Ask the students to write about what they drew, using key words that were listed during step 7. Add that writing to the appropriate mural section.

VARIATIONS
A. Students use the story for a book for which they develop illustrations.

B. Tell a succession story that describes a boreal forest after a fire.

## EXTENSIONS:

A. **Visit a forest and describe its stage.** Students visit a forested area near the school. Assign students the following question: Where is this forest in the rock's succession story? Students should answer the question using writing, discussion, and/or art.

B. **Create your own story of forest change.** Students find a rock in a forested area near the school. Student should leave the rock as found and show it to a partner or the teacher. Students then create a story for their newfound rock, relating it to forest succession.

## Credits:

"Guided Imagery: The Succession Story" written by Donna Matthews, revised by Robin Dublin and Elaine Rhode for this publication.

## Curriculum Connections:

(See appendix for full citations)

**Books:**
*The Ever-Living Tree* (Vieira)

*The Gift of a Tree* (Tresselt)

*How the Forest Grew* (Jasperson)

## Teacher Resources:

(See appendix)

# Guided Imagery: The Succession Story

***[Reading for Day One]***
You are a rock that the glacier has been sitting on. Imagine yourself under the glacier. The glacier's ice is very cold and heavy. The glacier moves ever so slowly, scratching you as it moves. Over thousands of years your edges have gotten smoother. Some little crumbles from your edges have been left behind as dust when the glacier rolled you along. You are always wet. You are always cold. The light is a strange blue darkness.

One day the darkness isn't as dark. There is a yellow glow that appears, but it flickers on and off. Three summers later, the blue darkness is gone. The yellow light is bright. You aren't wet all the time. Often you are very warm.
*[Years 1 to 3: Pioneer Stage]*

You find yourself on the edge of a little pond, surrounded by other rocks. Under you is a huge, flat, scratched rock. There is some dust in the neighborhood, but no soil, and no plants. Not a one. It's like that for another three winters. Then in spring a bird flies over and drops a seed. The seed lands right beside you on the dust. It rains a little and a few days later something green appears. Suddenly it seems there are green sprouts coming up every where there is dust.

Some green things introduce themselves as "moss" and others as "fireweed." They call themselves **pioneer plants** because they are the first green plants to come into the neighborhood. Their roots go down into the cracks in the rock under you.

Each spring there are more of these soft and friendly plants. Each spring their roots go deeper into the rocks around you, starting to make soil. Insects and birds come to visit. They tickle you as they hop on you looking for seeds and flowers. You can see soil now. There are old stems and flowers all mixed in with it. Some of this soil is next to you.
*[Years 4 to 9: Pioneer Stage]*

***[Reading for Day Two]***
Ten summers and 10 winters have passed since the blue glacier left you under the sky. Not too far away, there are wavy lines on the ground when the sun shines. Skinny line patterns get longer each spring. You wish you could turn and learn what they are. One day in the fall a pretty yellow leaf drifts by.

Now you know! Willows have joined the neighborhood! The lines are their branches making shadows on the ground. Alder shrubs and other bushy plants have also moved in. They send their roots deeper into the rocky ground. There is real soil here now. You can almost snuggle against it.

Watch out! There's a moose stepping on top of you! Whew. That was scary! Sometimes the snowshoe hares and chickadees sit on top of you. The pretty fireweed doesn't grow here any more. Where did it go, you wonder?
*[Years 10 to 99: Shrub]*

***[Reading for Day Three]***
Fluffy white things fall on you. It must be winter again and the snow is falling. But wait. It isn't cold! This must be cotton seeds from a cottonwood tree. You heard that cottonwood and a few spruce trees were in the neighborhood. It's been 100 summers since the glacier slipped away.

You like the way the light changes throughout the year – cool shade in the summer and warm sun in the spring and fall. You feel the ground rumble when the neighborhood bear wakes up and goes looking for roots to eat. Deer walk by and eat the buds of nearby bushes. A tiny shrew runs by you, with an insect in its mouth.
*[Years 100 to 199: Young Forest]*

***[Reading for Day Four]***
It's dark again. When there is light, it's green and full of shadows. Is this some strange night? Has the glacier come back? The soil is almost covering you – but not completely. The darkness isn't very cold, wet, or heavy like the glacier used to be.

Those yellow leaves – you haven't seen them for many falls now. Deer don't wander by very often, anymore. Voles don't dig near you like they used to. You notice that the snow doesn't pile up in the winter, either. What could have happened?

Two hundred winters have come and gone since the glacier left. It's a bit colder and dark again. Prickly pointed needles poke you. They don't turn into soil as fast as the colorful leaves did in earlier years. It's quieter here now that the sparrows and grouse have moved out of the neighborhood. The warblers still sing high in the tree tops. Wait a minute! That's it! The tree tops are way up in the sky.

Tree trunks are everywhere. There are three big, rough-barked spruce crowding around you. The spruce are crowded so thick that when you look up, you can no longer see the sun!

New plants aren't growing because the sun doesn't shine on them. The animals that used to live near you don't come by. The plants they used to eat are gone. Animals that eat the plant-eaters don't come either. For a rock, you're have seen a lot of changes.

The forest is very quiet now. For a rock as smart as you are, there is not much to watch. Will anything exciting ever happen again? You see hemlock trees among the spruce. Maybe hemlock trees are taking over. They like the shade of the darker forest. KABOOM!
*[Years 200 to 250: Mature Forest]*

***[Reading for Day Five]***
KABOOM! Was that an earthquake? No. But the ground is bouncing up and down. The roar is still echoing. At last – there's some excitement in the old neighborhood. Something is tickling you. A large spruce branch is sitting on you and there's dirt all over you, too. A huge old spruce tree must have fallen over. It crashed into other trees when it fell and broke their tops. You can feel the warmth of the sun shining on you.

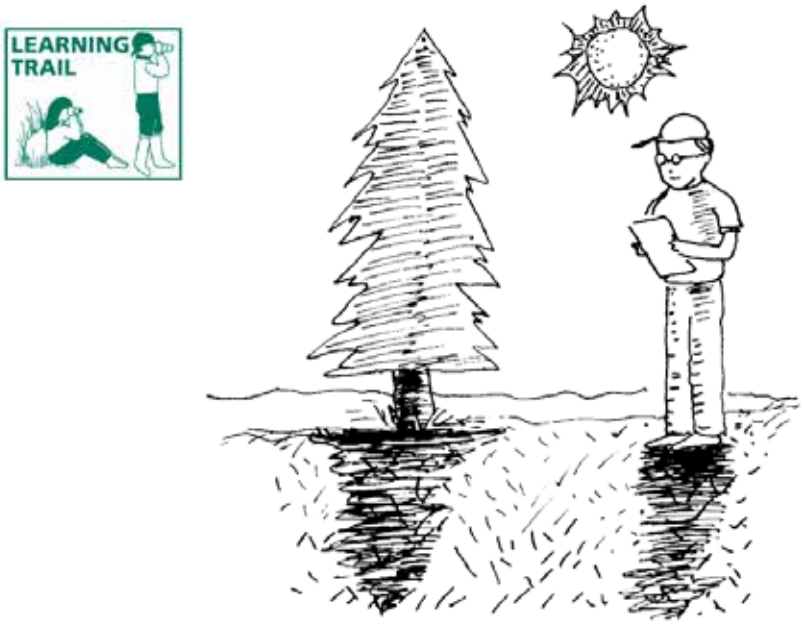
The tree rots away. Lots of little critters help turn the old tree into soft soil. Fungus helps too. You can feel the hairy parts of the fungus working around you. You are shoved by the roots of an elderberry bush as it pushes through the new soil. New willow and alder move in where the old spruce tree stood. They remind you of long ago. Young spruce are back!

Woodpeckers drilled holes in the trees with the broken tops. An owl family is using one of the holes. Deer visit in the winter. You see a little more snow now, but it doesn't slow down the deer. They eat the huckleberry twigs in the neighborhood.

A squirrel just popped its head out of the hole where she stores her spruce seeds for the winter. She tells you that some of the deer would not have survived the winter without those huckleberry twigs.

It's a busy place, this old forest, full of different kinds of plants and animals. It is an exciting place to watch because there is change all the time.
[Years 250 to 1,000 Old-growth Forest]

# Forests & Sunlight




*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 5 - 12

**NGSS:** MS-LS1-5, MS-LS2-1. MS-LS2-4

**Subject:** Science

**Skills:** Observing, measuring, inferring, comparing, drawing

**Duration:** 60 minutes

**Group Size:** Individuals

**Setting:** Outdoors & indoors

**Vocabulary:** canopy, ground cover, understory

## Objective:
Students will observe and compare densely forested and open forest sites to determine the role sunlight plays in a forest ecosystem.

## Complementary Activities:
*OUTDOORS:* "Forests and Soil" *in this section;* "Forests and Air" *in Section 1, Elements (both compare and contrast forested and non-forested sites). INDOORS:* "Tree Seed Chain Game" *and* "Forest Food Web Game," *both in Section 2, Ecosystem Connections.*

## Materials:
Clipboards and writing paper or field note books, pencils or pens for each student. Two sets of thermometers, five or more colored pencils, and copies of "Science Cards" for each student *(following pages)*.

## Background:
**See INSIGHTS, *Section 4, Succession.***

## Procedure:
*IN ADVANCE,* select two sites, one forested or densely forested, and one non-forested or open area.

*IN CLASS,* explain to students that they will be taking measurements at two forest locations to investigate the interrelationships between forests and the nonliving environment. Tell them they are to look for differences and determine what causes the differences.

## Classroom Follow-Up:
Students discuss the two Forest and Sunlight sites.
(a) Which site had the most plants in the shrub and ground cover layers? Was this the site where more or less sunlight reached the ground? Why would the amount of sunlight reaching the ground affect the number of plants growing there?

(b) In which site was the air warmer? How does the air temperature relate to the amount of sunlight reaching the ground?

(c) Which site, the sunny one or shaded one, would provide more food for animals that eat ground cover plants? Which site would provide more food for animals that eat shrubs? Would students expect to find more eaters of shrub and ground cover plants in a dense forest or in an open forest?

*Students should conclude that where more sunlight reaches the shrub and ground cover layers, more plants will grow, because plants need sunlight for photosynthesis. Sunnier sites will have more low-growing plants and thus more food for those animals that feed on those plants.*

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*America's Forests* (Staub)

*Biomes of the World (v.1)* (Allaby) 7-12

*Forests and Woodlands* (Pipes) K-6

*Taiga* (Kaplan)

*Taiga* (Sayre)

*U-X-L Encyclopedia of Biomes (v.3)* (Wigel) 7-12

**Website:**

Https://www.gi.alaska.edu/AlaskaScienceForum/administration

## Teacher Resources:

(See appendix)

**SCIENCE CARD**

# Forests & Sunlight: Dense Forest

1. Turn to a page of your field notebook and write the heading "Forests and Sunlight." Draw a line down the center of the page. Write a heading that describes this site on the left side of the paper.

2. As you look up, the main plants you will see are trees, if any occur at this site. These form the overstory or **canopy** layer of plants. As you look straight ahead, you may see another layer of plants, the **understory** or shrub layer. As you look down, you will see a **ground cover** layer of plants. Different sites usually have different numbers and kinds of plant layers. Some sites have only one of these layers. Other areas may have more layers – perhaps a tall tree, small tree, tall shrub, low shrub, and ground cover layer will be present.

3. Look around you and draw a picture on the left side of your page that shows the different layers of plants in this area. Use a different colored pencil to draw each layer. The number of lines you draw for each layer should show how many plant stems are in that layer. Draw in many lines to show that there are many plant stems. If there are large spaces between the plants in any layer, then draw just a few lines.

4. Look overhead at the number of leaves and branches. These block sunlight and prevent it from reaching the ground. How much sunlight do you think reaches the shrub layer at this spot: (a) nearly all sunlight, (b) some, but not all sunlight, or (c) very little sunlight? How much reaches the ground? Record your answers in complete sentences below your drawing.

5. Use the thermometer to measure the air temperature. Record this in your notebook below your drawing of this site.

SCIENCE CARD

# Forests & Sunlight: Open Site

1. In your field notebook, turn to the "Forests and Sunlight" page that you set up earlier or start a new page. Write a heading that describes this site on the right side of the paper.

2. As you look up, the main plants you will see are trees, if any occur at this site. These form the overstory or **canopy** layer of plants. As you look straight ahead, you may see another layer of plants, the **understory** or shrub layer. As you look down, you will see a **ground cover** layer of plants. Different sites usually have different numbers and kinds of plant layers. Some sites have only one of these layers. Other areas may have more layers – perhaps a tall tree, small tree, tall shrub, low shrub, and ground cover layer will be present.

3. Look around you and draw a picture on the right side of your page that shows the different layers of plants in this area. Use a different colored pencil to draw each layer. The number of lines you draw for each layer should show how many plant stems are in that layer. Draw in many lines to show that there are many plant stems. If there are large spaces between the plants in any layer, then draw just a few lines.

4. Look overhead at the number of leaves and branches. These block sunlight and prevent it from reaching the ground. How much sunlight do you think reaches the shrub layer at this spot: (1) nearly all sunlight, (2) some, but not all sunlight, or (3) very little sunlight? How much reaches the ground? Record your answers in complete sentences below your drawing.

5. Use the thermometer to measure the air temperature. Record this in your notebook below your drawing of this site.

# Forests & Soil


*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 7 - 12

**Subject:** Science
**NGSS:** MS-LS1-5, MS-LS2-1. MS-LS2-4, MS-LS1-5, MS-LS2-1. MS-LS2-3, MS-LS2-4,-ESS2-1

**Skills:** Observing, measuring, comparing, drawing

**Duration:** two 40 minute sessions 2 days apart

**Group Size:** Individuals

**Setting:** Outdoors & indoors

**Vocabulary:** Diversity, humus, invertebrates, leaf litter, pungent

## Objective:
Students will describe and compare soil composition found in forested and non-forest sites.

## Complementary Activities:
*OUTDOOR:* "Forests and Sunlight" *in this section;* "Forests and Air" *in Section 1, Elements (both compare and contrast forested and non-forested sites).* "Detritivores" *and* "Insect Signs," *both in Section 2, Ecosystem Connections. INDOORS:* "Forest Food Web Game" *in Section 2.*

## Materials:
*OUTDOORS* – Clipboards and writing paper or field note books, pencils or pens for each student. At both forested and non-forested sites: thermometer, colored pencils, ruler or yard/meter stick, plastic bag, labels, trowel. Copies of "Science Cards" *(following).*
*CLASSROOM* – Scale for measuring weights; small paper or aluminum cups; a sunny, dry spot or an oven; a light; funnel; screen; flask; hand lens or binocular microscope. OPTIONAL: Soil core sampler *(contact foresters or soil scientists to see about using one of these tools*).

## Background:
***See* INSIGHTS, *Section 4, Succession.***

## Procedure:
*IN ADVANCE,* select 2 sites – one **forested** (F) and one a **non-forested** (NF) where students can compare the soils.

Prepare each site by digging a 1- to 2- foot deep soil pit or by using a soil core sampler to extract a soil sample.

*IN CLASS,* explain to students that they will be taking measurements at a two locations, one forested and one without trees. They will investigate the impact of trees on soil formation.

## Classroom Follow-Up:
1. Students compare drawings of the two Forests and Soil sites. Which site had the thickest layers of leaf litter and **humus** (*dark organic material*)? Why do they think this difference occurred?

2. Students measure equal amounts by weight of soil samples F-2, F-3 (if collected) and NF-2, NF-3 (if collected) and place them in separate cups. Record the weights and evaluate which smells more **pungent** (*sharper and stronger*).

3. Place the samples in the sunlight or in a low-heat oven to dry them. Then, students reweigh them. Subtract the second weight of each bag from its first weight. This

will tell how much moisture was in each sample. Which sample contained more moisture? Why?

4. Use soil samples F-1 and NF-1 to set up a Berlyse Funnel as shown. Wait 24-48 hours, then examine the contents of each flask using a hand lens or binocular scope.

Which sample contained the greatest number of soil invertebrates? Which sample contained the greatest **diversity** of invertebrates? How do students explain the differences in the samples?

*Students should find that the leaf litter and humus layer of soil is deeper in the forested area, and that the soil is darker. They should also find that the forest soil sample smelled more pungent, contained more moisture, and a greater number and variety of invertebrates.*

*These differences are interrelated. The organic layer of soil is formed through decay of the leaf litter and is mixed with the next soil layer by invertebrates. Organic material smells pungent, holds water, and provides food for invertebrates.*

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*Biomes of the World (v.1)* (Allaby) 7-12

*Taiga* (Kaplan)

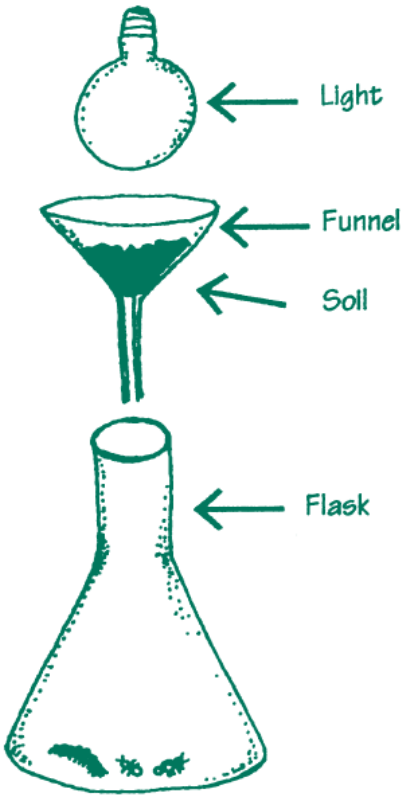
*Taiga* (Sayre)

*U-X-L Encyclopedia of Biomes (v.3)* (Wigel) 7-12

**Website:** Alaska Science Forum
https://www.gi.alaska.edu/AlaskaScienceForum/

## Teacher Resources:

(See appendix)




**Berlyse Funnel**

SCIENCE CARD

# Forests & Soil: Forested Site

1. On the top of a page in your field notebook, write the heading "Forests and Soil." Draw a line down the center of the page. Write a heading that describes this site on the left side of the paper. Record your answers to the questions on the left side of the page.

2. Look carefully at the soil pit or core sample. Can you see different layers in the soil? Draw a picture of the different layers in your notebook using the colored pencils to show the differences in color.

3. Measure the thickness of each layer and record it next to that layer in your drawing.

4. Look carefully at each layer of soil. Scrape a small amount of soil from each layer and look at it with the hand lens. What do you think each layer is made of? Record your answers next to your drawing.

5. Collect a trowel full of soil from the top layer of the ground and place it in a plastic bag. The top layer should contain litter and **humus** (*dark organic material*). Seal the bag tightly and label it "Soil Sample F-1."

6. Collect samples from the other soil layers. Place the samples from each layer in a separate plastic bag and label each "Soil Sample F-2" and "Soil Sample F-3," etc. Label your drawing of the soil layers with the same labels you used for your soil samples (F-1, F-2, etc.).

SCIENCE CARD

# Forests & Soil: Non-forested Site

1. Use the "Forests and Soil" page of your field notebook that you set up earlier, or write the heading "Forests and Soil" on a new page. Write a heading that describes this site on the right side of the paper. Record your answers to the questions on the right side of the page.

2. Look carefully at the soil pit or core sample. Can you see different layers in the soil? Draw a picture of the different layers in your notebook using the colored pencils to show the differences in color.

3. Measure the thickness of each layer and record it next to that layer in your drawing.

4. Look carefully at each layer of soil. Scrape a small amount of soil from each layer and look at it with the hand lens. What do you think each layer is made of? Record your answers next to your drawing.

5. Collect a trowel full of soil from the top layer of the ground and place it in a plastic bag. The top layer should contain litter and **humus** (*dark organic material*). Seal the bag tightly and label it "Soil Sample NF-1."

6. Collect samples from the other soil layers. Place the samples from each layer in a separate plastic bag and label each "Soil Sample NF-2" and "Soil Sample NF-3," etc. Label your drawing of the soil layers with the same labels you used for your soil samples (NF-1, NF-2, etc.).

# Change in Our Lives

## 1 EXTENSION

*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 4 - 6

**State Standards:** L A-1, L A-2, L A-3, Geo A-3, Geo E-5
**NGSS:** 4-ESS1-1,MS-LS1-5

**Subjects:** Science, social studies, language arts

**Skills:** Observing, predicting, comparing, research, interviewing, writing

**Duration:** Two 45-minute class periods

**Group Size:** Small groups

**Setting:** Indoors

**Vocabulary:** Disturbance, succession, timeline

### Objectives:
Students will compare the changes in their own lives to those that occur in forests.

### Teaching Strategy:
Students compare pictures of themselves, their school, neighborhood, or community to see that change is a process over time and occurs in all living things.

### Materials:
Pictures, photographs of the students, the school, or the community through as many years as possible; forest succession charts from *INSIGHTS, Section 4, Succession.*

### Background:
**See INSIGHTS, *Section 4, Succession.***

### Procedure:
*IN ADVANCE,* ask students to bring pictures of themselves taken over a number of years.

1. *IN CLASS,* introduce the activity by reading aloud the poem, "Now I Am Six," by A. A. Milne.

When I was one, I had just begun.
When I was two, I was nearly new.
When I was three, I was hardly me.
When I was four, I was not much more.
When I was five, I was just alive!
But now I am six, I'm clever as clever,
I think I'll stay six now for ever and ever!

2. Discuss staying the same always. What would be the advantages or disadvantages of staying the same age forever? Would the situation be the same if you stopped growing, but no one else did?

3. Students individually lay out their pictures in a timeline. And then work in small groups to identify how they've changed over time. Next, students **write** about the differences they see, creating a narrative for their personal photo **timeline**.

4. Students predict what they will look like in one month; in one year; in 20 years (How old will they be?); in 50 years (How old will they be?). Write those predictions on their timelines.

5. Brainstorm with the class which changes students can and cannot control. Discuss the inevitability of change for living things. Explain that change takes place in forests in a pattern called **succession.** Sometimes fire or bulldozers interrupt the pattern and start it over.

6. What do students think the natural area around their school looked like 50 years ago? 20 years ago? 10 years ago? 5 years ago? They should collect as many pictures as possible of the school and/or community from friends, relatives, newspapers, or the local school district office.

7. Students also interview people living and working in the community for verbal descriptions, always recording the dates being described. *(It may be possible for you to obtain archive photos from land management agencies, historic groups, or community councils for use in this activity.)*

8. When all the information is collected, the class constructs a schoolyard or community **timeline**. Illustrate the timeline with pictures that are copies of the photographs or drawings made by students. Emphasize natural growth and change around the school whenever possible.

9. Students compare their personal timelines to the schoolyard or community timeline. What did the area around the school look like before the school was built? Before they were born? What kind of **disturbance** did the school construction cause? What kinds of changes take place slowly? Quickly? What causes the changes? Which of the changes in a forest community can people control to some degree, and which can we not control? Ask the students to predict what the schoolyard will look like in 50 years. In 100 years.

## Evaluation:

Students create drawings of themselves through time. Students create drawings of a forest through time. Students compare the two drawings.

## EXTENSION:

**Plan to enhance schoolyard.** Develop a schoolyard habitat project. Students study their schoolyard area, discuss what they can do to invite plant life and wildlife into the area, and plan work projects to enhance the schoolyard. For more information, refer to Project Wild's *WILD School Sites* booklet or contact the National Wildlife Federation.

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*Ancient Ones, The World of the Old-Growth Douglas Fir* (Bash)

*Changing City* (Muller)

*Changing Countryside* (Muller)

*Farewell to Shady Glade* (Peet)

*Window* (Baker)

*Tuck Everlasting* (Babbitt)

## Teacher Resources:

(See appendix)

**One living tree provides the oxygen needed by one person daily.**

# Succession's Path
## 2 EXTENSIONS

*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 5 - 12

**State Standards:** Geo C-1, Geo C-2, Geo C-3, Geo E-5
NGSS: 4-ESS1-1,MS-LS1-5, MS-LS2-4., MS-ESS2-2., HS-LS2-6,HS-ESS2-7

**Subjects:** Science, social studies

**Skills:** Analyzing, reasoning, classifying

**Duration:** 30 minutes

**Group Size:** 2-5

**Setting:** Indoors

**Vocabulary:** Climax community, competition, disturbance, mineral soil, organic soil, pioneer, primary succession, secondary succession, sere, snag, succession

### Objectives:
1. Students will describe the difference between primary and secondary succession.

2. Students will name 2-10 disturbances that set back succession.

### Teaching Strategy:
Students play the "Forest Succession Game" to demonstrate how succession works in our coastal rainforest and the Interior boreal forest.

### Materials:
For each group: a copy of the "Forest Succession Game" board, Disturbance Cards 1 and 2, game rules, First Guess markers *(photocopy from following pages),* any type of game markers for each student, a die for each group, scratch paper and pencil for keeping score.

### Background:
**See INSIGHTS, *Section 4, Succession.***

### Procedure:
1. Ask students whether they think ecosystems ever change. Ask for examples. Will the area around the school look different when they are older and have their own children? Did the area look any different when they were born?

2. Discuss the differences between primary and secondary succession. Students list some disturbances that might change a forest. Record their observations in 1 of 2 columns on the board labeled for primary succession and secondary succession. Students decide which disturbances fit under each category.

3. Divide the class into groups no larger than five. Give each group items in the materials list. Play the "Forest Succession Game." Players try to move from the start (Begin Primary Succession) to the end (Old-growth or Climax Forest). They earn points by grabbing the First Guess Marker first and correctly identifying the effects of a disturbance (stating whether it results in primary or secondary succession).

4. After the game, students summarize the possible effects of disturbances on succession. Review the differences between primary and secondary succession.

## Evaluation:

1. Students name five disturbances which change the course of forest succession and describe their potential effects.

2. Students decide whether the forest succession would be primary or secondary when the teacher shows pictures or reads descriptions of a variety of momentous events (volcanic eruptions, earthquakes, fires).

# EXTENSIONS:

A. **Build shadow box forest succession.** Students build a shadow box example of a primary and a secondary succession forest.

B. **Design questions for new game of succession.** Students work in teams of 2-4 to create and play their own forest succession games.

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*Ancient Forests* (Siy)

*The Ever-Living Tree* (Vieira)

*Fire: Friend or Foe* (Patent)

*Fire in the Forest: A Cycle of Growth and Renewal* (Pringle)

*A Forest's Life* (Mania)

*How the Forest Grew* (Jasperson)

*Taiga* (Kaplan)

*Wildfires* (Simon)

**Media:**

*Birth of a Forest: A Forest Grows Old* (Video)

*Old Growth Forest: an Ecosystem* (Video) (National Geographic)

**Website:**

Alaska Science Forum
<www.gi.alaska.edu/ScienceForum>

## Teacher Resources:

(See appendix)

**The stiff-scaled cones of the black spruce stay on the tree for many years and are opened by fire or years of drying in the sun.**

# Forest Succession Game Rules

1. All players start on the square marked **"New Land – Begin Primary Succession Here."** Players each toss the die once to find out who plays first. Lowest number plays first. Play then rotates to the left.

2. A player rolls the die and moves the marker ahead the number of spaces indicated on the die.

3. If the player lands on a blank space, the turn rotates to the next player.

4. Any player who lands on a Disturbance square must draw a card from the **Disturbance Card Pile** indicated on the board (pile #1 or #2). Other players listen as the player reads the kind of disturbance and its effects listed on the card. The player stops reading as soon as any other player grabs the **"First Guess Marker"** *(see next step)* or before reading the line telling the kind of succession that results.

5. When any player draws a **Disturbance Card** and begins reading it, all other players have a chance to earn a game point. All players listen to the type of disturbance described on the card. As soon as any player knows whether this disturbance results in primary or secondary succession, that player should reach for the **"First Guess Marker."** The first player to grab the marker gets a chance to guess. The answer is always either primary or secondary succession. A player who guesses correctly earns one point. Anyone who guesses incorrectly loses one point. Individual points are recorded on the score sheet.

6. The player who drew the Disturbance Card must then move her/his marker as instructed on the card (back a number of spaces or back to the primary or secondary succession squares). Return the Disturbance Card to the bottom of its original pile (#1 or #2). Play rotates to the next player on the left.

7. The game ends when any player reaches the **Climax Forest** square, but the WINNER is the player who earns the most points.

**FIRST GUESS MARKER**

**BEGIN HERE**
**Primary Succession**
**New Land:**
**Rocks and Mineral Soil only**

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

**Secondary Succession Begins Here:**
**organic soil in place**

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

**Disturbance!**
Take a card
from card pile #1

# The Forest Succession Game

Pioneer Stage — 0 years — Transition — Shrub Stage — 5-10 years — Transition — Young Forest Stage — 20-40 years

**Disturbance!**
Take a card
from card pile #2

**Disturbance!**
Take a card
from card pile #2

**Disturbance!**
Take a card
from card pile #2

# Disturbance Cards 1

**Disturbance!**
Take a card
from card pile #2

**Disturbance!**
Take a card
from card pile #2

# Disturbance Cards 2

**Disturbance!**
Take a card
from card pile #2

**Disturbance!**
Take a card
from card pile #2

**Disturbance!**
Take a card
from card pile #2

Mature Forest Stage — Old-growth or Climax Forest

Transition — 50-70 years — 100-200 or more years

DISTURBANCE CARD #1

## VOLCANO ERUPTS

New land is created; all previous inhabitants are destroyed.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #1

## GLACIER ADVANCES AND THEN RETREATS

All organic soil is removed; new rocks and mineral soil are deposited; all previous inhabitants are gone.
*Begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #1

## EARTHQUAKE UPLIFTS NEW LAND

New land is created.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #1

## FLOOD ERODES SOIL AND DEPOSITS IT IN A NEW PLACE

New land is created.
*Begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #1

## INSECT OUTBREAK KILLS TREES

Soil and other plants remain, along with some live trees.
*Go back 5 spaces.*

**(Secondary Succession)**

DISTURBANCE CARD #1

## TIMBER HARVEST REMOVES TREES

Trees are harvested by selective cutting, so only some are removed. Many remain on the site, along with other live plants. The soil is disturbed and many plants are killed.
*Go back 6 spaces.*

**(Secondary Succession)**

DISTURBANCE CARD #1

## LAND CLEARED BY HUMANS

All organic soil is removed to allow mining of rocks beneath.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #1

## WILD FIRE!

This fire burns moderately hot, so some organic soil remains along with many roots, seeds, and live plants.
*Go back and begin Secondary Succession again.*

**(Secondary Succession)**

DISTURBANCE CARD #1

## WILD FIRE!

This fire burns moderately hot, so some organic soil remains along with many roots, seeds, and live plants.
*Go back and begin Secondary Succession again.*

**(Secondary Succession)**

DISTURBANCE CARD #1

## LANDSLIDE

All organic and mineral soils are eroded, leaving a rubble of rocks and bedrock.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #1

## INSECT OUTBREAK KILLS SAPLINGS

Mineral and organic soils remain, along with roots, seeds, some healthy young trees, and other plants.
*Go back 4 spaces.*

**(Secondary Succession)**

DISTURBANCE CARD #1

## AVALANCHE

Mineral and organic soils remain, along with roots, seeds, and live shrubs.
*Go back 5 spaces.*

**(Secondary Succession)**

DISTURBANCE CARD #2

## VOLCANO ERUPTS

New land is created; all previous inhabitants are destroyed.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #2

## GLACIER ADVANCES AND THEN RETREATS

All organic soil is removed; new rocks and mineral soil are deposited; all previous inhabitants are gone.
*Begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #2

## EARTHQUAKE UPLIFTS NEW LAND

New land is created.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #2

## FLOOD ERODES SOIL AND DEPOSITS IT IN A NEW PLACE

New land is created.
*Begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #2

## INSECT OUTBREAK KILLS TREES

Most old trees are killed, but soil and a variety of other plants remain, along with many young trees.
*Go back 7 spaces.*

**(Secondary Succession)**

DISTURBANCE CARD #2

## TIMBER HARVEST REMOVES TREES

Some organic soil is lost through erosion, but much remains, along with many seeds, roots, and live plants.
*Go back and begin Secondary Succession.*

**(Secondary Succession)**

DISTURBANCE CARD #2

## LAND CLEARED BY HUMANS

Some mineral and organic soil remains.
*Go back and begin Secondary Succession again.*

**(Secondary Succession)**

DISTURBANCE CARD #2

## WILD FIRE!

This fire burns very hot, so all organic soil is burned and nearly all roots, seeds, and live plants are killed.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #2

## WIND STORM BLOWS DOWN TREES

Mineral and organic soils remain, along with roots, seeds, and live plants.
*Go back to Begin Secondary Succession again.*

**(Secondary Succession)**

DISTURBANCE CARD #2

## LANDSLIDE

All organic and mineral soil are eroded, leaving a rubble of rocks and bedrock.
*Go back and begin Primary Succession again.*

**(Primary Succession)**

DISTURBANCE CARD #2

## DISEASE OUTBREAK KILLS TREES

Mineral and organic soils remain, along with roots, seeds, live young trees, and other plants.
*Go back and begin Secondary Succession again.*

**(Secondary Succession)**

DISTURBANCE CARD #2

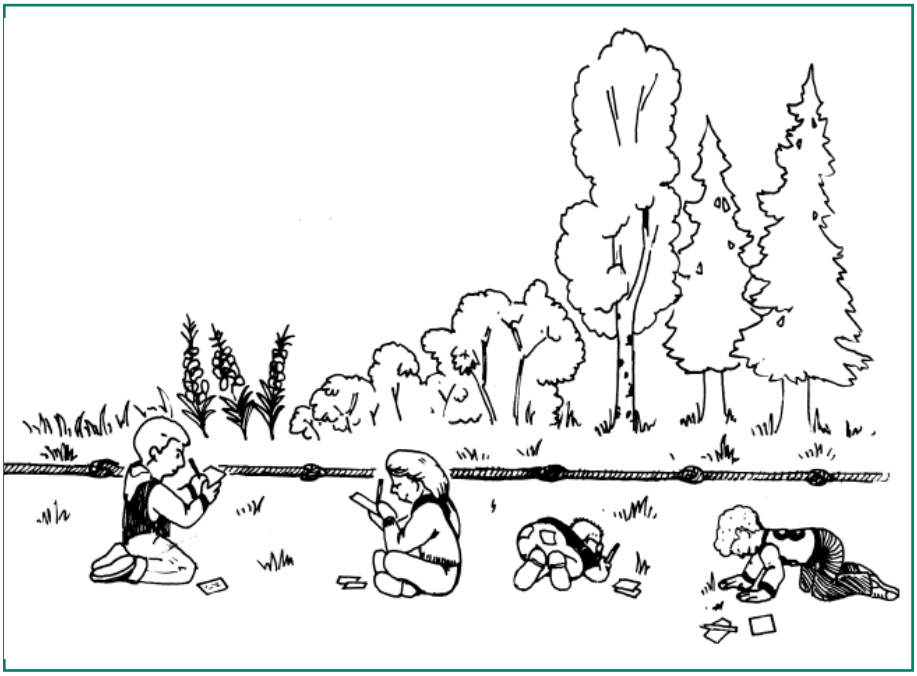
## AVALANCHE KNOCKS DOWN TREES

Mineral and organic soils remain, along with roots, seeds, and live plants.
*Go back and begin Secondary Succession again.*

**(Secondary Succession)**

# Flipbook Succession

**1 EXTENSION** ***ALERT: ALASKA ECOLOGY CARDS OPTIONAL***



*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 4 - 8

**NGSS:** 4-ESS1-1, 4-ESS1-1
4-ESS1-1

**Subjects:** Science, social studies, art

**Skills:** Observing, recording, drawing

**Duration:** 50-100 minutes

**Group Size:** 1-3

**Setting:** Outdoors and indoors

**Vocabulary:** Herbs, pioneer, sere, shrubs, succession, successional stage, transect

## Objective:

Students will identify and record the successional stages of a local forest.

## Teaching Strategy:

As students walk (or crawl) along a transect line, they will observe differences in the types and abundance of plants, draw these changes, and make a flipbook to show stages of succession along a transect.

## Materials:

Enough 3 x 5 cards (or 5 x 7) for each student to have at least 10 cards, two brass fasteners per student, one clipboard or cardboard for drawing surface per student, pencils, hole punch, rope long enough to signify a transect from pioneer stage to climax forest (several hundred feet maximum).

OPTIONAL: *Alaska Ecology Cards*, separate cards or construction paper for booklet covers.

*Note: This activity works well if you familiarize yourself with local plants prior to doing the activity with students. You may also invite a botanist, forester, naturalist, knowledgeable community member, or elder into class to assist you with this activity.*

## Background:

**See INSIGHTS, *Section 4, Succession.***

## Procedure:

*IN ADVANCE,* locate an area with plants ranging from **pioneer** stage through as many **successional stages** as possible to **climax** forest. Spring, summer, or fall will give more successional clues. *Look for such areas where gravel pits, dirt parking lots, or abandoned fields meet a forest.*

1. *IN CLASS,* review your forest's (coastal or boreal) **succession charts** *(see* INSIGHTS, *Section 4*) with students before making a visit to the site. Explain that students have new jobs as foresters, botanists, or biologists. Their first assignment is to describe the **successional stages** at a nearby site.

2. *AT THE OUTDOOR SITE,* students number the cards to match the number of knots/markers on the transect line.

3. Set up the **transect** by laying the rope along the ground across the area. *For example, start one end of a 100-foot trope on the edge of an abandoned dirt parking lot and stretch it into the adjacent woods.* The rope becomes a visual cross-section.

4. Make knots in the rope at spots where you want students to draw a picture of the successional stage, *OR* put flagging tape or other marker at the observation spots.

5. Students draw as much as they can on an index card at each station. Encourage students to observe all the kinds of herbs, shrubs, and trees at each spot, and to make their drawings in profile, as if they were lying on the ground looking head-on at the plants *(as in the succession charts)*.

6. *As students move along the rope, they will notice that the numbers and kinds of low growing annual plants like fireweed decrease. As they move into the forest, small trees may begin to appear. By the time they reach the forest, they might find tall spruce, hemlock, or birch with thick sphagnum moss on the ground.*

7. *BACK IN CLASS,* give students time to complete the details in their drawings.

8. Students arrange the cards in successional order, punch holes in the cards, and fasten them with the brass fasteners. Covers are optional. Students may work in groups of 2 or 3.

9. Students refer to their succession charts to label the various stages or **seres** they observed.

10. Practice flipping through the stages of succession, and watch the forest grow!

## Evaluation:

1. Students put a new set of pictures in successional order and label the stages.

2. Students arrange a set of written forest descriptions in successional order, adding a drawing, and label to each one.

## EXTENSION:

**Make puzzles out of the succession cards.** Students cut their succession cards into puzzle pieces for classmates to reassemble.

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*The Gift of a Tree* (Tresselt)

*How the Forest Grew* (Jasperson)

*Taiga* (Kaplan)

## Teacher Resources:

(See appendix)

**An ancient tree still lives in Alaska. Fossil records tell us that the plant, horsetail or *equisetum*, was once a mighty tree. It grows about a foot tall now and is no longer a true tree. You can see horsetail in many disturbed areas. (#25 of *Alaska Ecology Cards*)**

# Animal Adaptations for Succession

***ALERT: ALASKA ECOLOGY CARDS REQUIRED***

*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 3 - 8
**State Standards:** Geo E-5
NGSS: 3-LS4-3, 3-LS4-4,4-LS1-1 MS-LS1-5, MS-LS2-1MS-LS2-2. MS-LS2-4, MS-ESS2-2, HS-ESS2-7
**Subjects:** Science, art, language arts
**Skills:** Comparing, differentiating, analyzing, reasoning, reading, writing
**Duration:** 2 or 3 50-minute sessions
**Group Size:** Whole class
**Setting:** Indoors
**Vocabulary:** Adaptation, cambium, conifer, deciduous, ground cover, habitat, predator, shrub, snag, succession, successional stage

## Objective:
Students will match wildlife species to the forest successional stage where they are most likely to be found.

## Teaching Strategy:
Students draw a mural of plant successional stages and list the appropriate wildlife beneath each stage.

## Complementary Activities:
*OUTDOOR/INDOOR:* "Flipbook Succession" *and* "Snag a Home," *both in this section.*

## Materials:
*Alaska Ecology Cards; c*opies of succession charts (*from* INSIGHTS, *Section 4, Succession*); butcher paper; ruler or yard stick; pencils; crayons, markers or paints; tape or paste. Copies of forest-organism list *(following page).* Worksheets: "Who Lives Where?" and "Where's Home?" *(following pages*).

## Background:
**See INSIGHTS, *Section 4, Succession.***

## Procedure:
1. Divide the class into several groups, if desirable, or have everyone work on one large mural.

2. Students draw a line dividing the butcher paper into an upper and lower section. Use the top portion to draw plants of the successional stages in your area *(from charts in* INSIGHTS, *Section 4)*. The drawing should fill all the space above the line. Label the stages. Leave the bottom portion for the following steps.

3. Referring to the lists below, students use the *Alaska Ecology Cards* that feature species from either the **boreal forest** or Pacific **coastal rainforest** to find clues to where the animals will be found.

4. Students start drawing a line where an animal would *first* appear and continue the line under each successional stage that the animal can use *(see illustration).* Label the line with the animal's name.

5. Students draw or paste pictures of the animals on the line with its name and/or in the mural scene at the appropriate stage(s).

6. Discuss with students what effects disturbance of a forest by fire, timber harvest, or insect outbreak might have on wildlife. *(They should conclude that the effects depend on the animal and the successional stage of the forest after each event. Disturbances benefit some wildlife species while decreasing the numbers of others.)*

Evaluation:
1. Students answer the worksheets: "Who Lives Where?" and "Where's Home?"

2. Students write a short report comparing and contrasting the animals and their adaptations in the early pioneer and climax stages of succession. Students should note any similarities and detail the differences among the animals' adaptations.

## Curriculum Connections:
(See appendix for full citations)

**Books:**
*A Dead Log* (Green)

*Alaska Wildlife Notebook Series* (ADF&G)

*Dead Log Alive* (Kittinger)

*How the Forest Grew* (Jasperson)

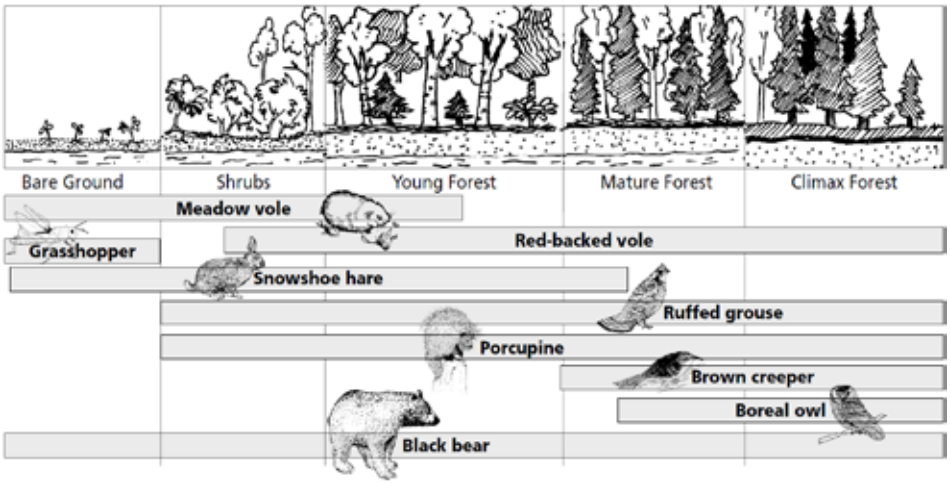
*Log's Life* (Pfeffer)

**Media:**
*Old Growth Forest: an Ecosystem* (Video) (National Geographic)

## Teacher Resources:
(See appendix)

**BOREAL FOREST**
Sunlight
Air
Water
Rocks and soil
White spruce tree
Red squirrel
Goshawk
Carrion beetle
Bacteria
Gilled mushroom
Bark beetle
Hairy woodpecker
Sharp-shinned hawk
Birch tree
Moth
Chickadee
Truffle
Bacteria
Springtail
Flying squirrel
Low-bush cranberry
Vole
Great horned owl
Weasel
Polypore or shelf fungi
Protozoans
Lichen
Moose
Grouse
Hare
Lynx
Algae

**COASTAL FOREST**
Sunlight
Air
Water
Rocks and soil
Sitka spruce
Red squirrel
Goshawk
Carrion beetle
Bacteria
Gilled mushroom
Bark beetle
Red-breasted sapsucker
Sharp-shinned hawk
Hemlock tree
Sawfly wasp
Chickadee
Truffle
Bacteria
Springtail
Flying squirrel
Trailing raspberry
Moth
White-footed deer mouse
Marten
Polypore or shelf fungi
Protozoans
Lichen
Deer
Grouse
Crossbill
Wolf
Algae




**Dead trees are valuable in the forest. Standing dead trees called snags are soft enough to be drilled by woodpeckers. Birds adapted for cavity-nesting such as boreal owls appreciate these homes in the sky.**

# Who Lives Where?

Which successional stage of the **boreal forest** is home for each of these animals? Compare the animal's needs to the description of secondary succession to figure this out. Fill in the number(s) of the successional stage(s) in which you think each animal could survive best.

A ___ ___

Flying squirrels eat fungi, berries, and seeds. They need standing live or dead trees to glide between. They escape predators by hiding among the branches of live trees. They need holes in snags to nest and rest.

B ___ ___ ___

Voles eat seeds, berries, and fungi. They need many fallen logs, shrubs, and small plants to hide under.

C ___ ___

Crossbills eat only the seeds of conifers and the insects that live in the tops of conifers. They also nest in conifer trees.

D ___ ___ ___ ___

Three-toed woodpeckers feed on insects that bore into the bark of dead and dying spruce trees. They need large snags to dig holes for nesting and resting places.

E ___

Moose eat the branches and leaves of birch, aspen, and willow. They cannot reach the branches of old trees, so they need saplings and tall shrubs.

F ___ ___

Boreal chickadees eat seeds and insects that feed on conifers. For nesting, chickadees dig holes in large snags. They hide from predators in the branches of conifers.

G ___ ___

Ruffed grouse live in broadleaf forests. They feed mainly on the buds of birch and aspen trees. They often rest in conifer trees, but they nest on the ground under shrubs.

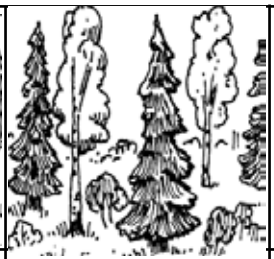
H ___ ___ ___

Red foxes eat voles and can only live in places where many voles live. Foxes dig dens under fallen logs, or into the ground under trees or shrubs.

**1. Regrowth Herb Stage**: Fire releases many stored nutrients. Plants and fungi begin growing soon after the fire. There are standing dead and dying **snags** of spruce and broadleaf trees. Few have fallen to the ground.

**2. Regrowth Shrub Thicket**: Within 3 to 15 years, the site is covered by tall shrubs and saplings (willow, aspen, birch). A variety of non-woody plants (herbs) are growing. Dead trees lie on the ground, but many large snags remain.

**3. Young Forest**: In 30 to 50 years, birch, aspen, and willows have grown into young trees. Slow-growing spruce are still small. Few snags remain. Fewer shrubs and ground cover plants grow in this stage than in other successional stages.



**4. Mature Forest**: In 75 to 100 years, the spruce are taller than the broadleafs. The forest is more open because many broadleafs have died. A few broadleaf snags have nest holes in them. Fungi and seed- and berry-producing shrubs and herbs grow here.

**5. Old-Growth Forest**: By 150 to 200 years, mainly spruce remain. The forest is fairly open and contains many large, dead spruce and broadleaf trees with holes. The forest floor is covered by fallen logs, and mosses, and berry plants.

# Where's Home?

Which successional stage of **coastal rainforest** is home to each of these animals? Compare the animal's needs to the descriptions of secondary succession to find the answer. Fill in the number(s) of the successional stage(s) in which you think each animal could best survive.

A ___ ___

Flying squirrels eat fungi, berries, and seeds. They need standing live or dead trees to glide between. They escape **predators** by hiding among branches of live trees. They need holes in trees for dens.

B___ ___

Porcupines eat the **cambium** layer of live hemlock and spruce trees, along with the branches and leaves of shrubs and ground cover plants. Their quills protect them from most predators.

C ___ ___

Crossbills eat only the seeds of **conifers** and the insects that live in the tops of conifers. They also nest in conifer trees.

D ___ ___

Red-breasted sapsuckers feed on insects that bore into the bark of dead and dying spruce trees. They need snags to dig the holes for nesting and resting places.

E ___

Sitka black-tailed deer eat a variety of **ground cover** plants, lichens, and the twigs of **shrubs** such as huckleberry. They need areas without deep snow to find food and escape predators in winter.

F ___

Chestnut-backed chickadees eat seeds and insects that feed on conifers. To make nests, they dig holes in large snags. They hide from predators in the branches of conifers.

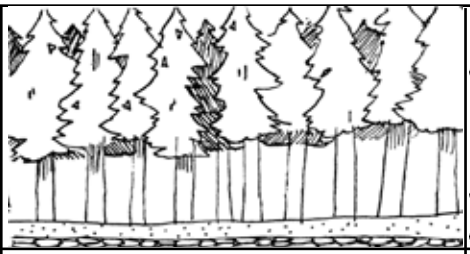
G ___ ___

Dark-eyed juncos eat insects and the seeds of ground cover plants and insects. They nest on the ground under logs, branches, or shrubs.

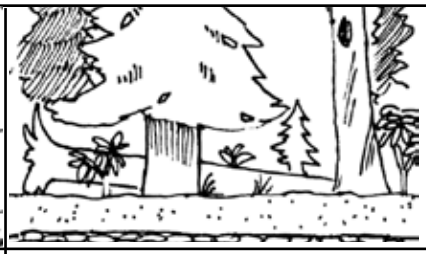
H ___

Bald eagles eat fish and dead animals. They build huge stick nests in large, old conifers and **deciduous** trees (cottonwoods and poplars).

**1. Regrowth Stage**: Many plants begin growing soon after timber harvest. Within 3-5 years, the site is covered by tall shrubs and saplings (alder, huckleberry, spruce, hemlock). Their shade forces out many sun-loving ground cover plants. Branches, stumps, and logs cover the ground, making travel through here difficult. A few standing dead trees (**snags**) remain. In hard winters, 6-8 feet of snow may cover the ground.



**2. Second-Growth Forest**: Within 15-30 years, the site is thickly covered by hemlock and Sitka spruce. These conifers shade the forest floor so very few shrubs or ground cover plants can grow. No large snags remain. The conifer branches catch the snow, keeping ground snowcover light even in severe winters.



**3. Old-Growth Forest**: By 250-600 years, very large trees as well as young seedlings and saplings grow here. Openings in the canopy allow sunlight to reach the forest floor, so a variety of shrubs and ground cover plants can grow. There are many large snags, hollow trees, and fallen logs. Branches of the large trees prevent snow from covering shrubs and ground cover plants even in severe winters.

# Snag a Home

*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 5 - 12

**NGSS:** 5-LS2-1, MS-LS2-2., MS-LS2-3.,HS-LS2-4

**Subjects:** Science, social studies

**Skills:** Observing, inferring, predicting

**Duration:** 50-100 minutes

**Group Size:** Small or individuals

**Setting:** Outdoors & indoors

**Vocabulary:** Detritivores, food webs, habitat, photosynthesis, predator, prey, snags

## Objective:
Students will look for evidence that dead trees are habitat for forest wildlife.

## Complementary Activities:
*OUTDOOR:* "Fungi," "Detritivores," "Bird Signs," *and* "Animal Signs," *all in Section 2, Ecosystems;* "Bird Song Tag" *in Section 3, Forest Learning Trail. INDOOR:* "Forest Food Web Game" *in Section 2, Ecosystems; and* "Animal Adaptations for Succession" *in this section.*

## Materials:
Clipboards and writing paper or field note books, pencils or pens for each student. Hand lens; field guide such as *Peterson Field Guides: Ecology of Western Forests.* Copies of "Snag a Home Science Card" *(following).*

## Background:
**See INSIGHTS, *Section 2, Ecosystems – Community Connections;* and *Section 4, Succession.***

## Procedure:
*IN ADVANCE,* locate forest site with a standing dead tree and a fallen dead tree, preferably one that fell several years ago and pulled up its roots when it fell.

1. *IN CLASS,* discuss the concept of **habitat** and remind students that forests can provide habitat even when some trees are dead. At what stages in forest succession are snags present? *(Coastal rainforest — in regrowth after floods, avalanches, timber harvest, beetle kills, or other disturbance; also in old-growth stage. Boreal forest – in regrowth after fire, shrub thicket stage, and in old growth stage.)*

2. Students will use their detective skills to find as many signs as possible of wildlife living in **snags** and fallen trees. Ask them to be on the lookout for links in the forest food web.

3. Give each student or group the "Snag a Home Science Card."

## Classroom Follow-Up:
1. From their collective field observations, students compile a master list of wildlife that use dead trees. Students may need to identify evidence of organisms drawn earlier in their notebooks by using a field guide or other reference.

2. Using the list, students build at least 3 forest food chains that include dead trees.

3. Discuss how the removal of all dead trees might affect a forest? *Students should think carefully about which living things use dead trees, and how minerals are cycled.*

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*Ancient Forests* (Siy)

*Ancient Ones, The World of the Old-Growth Douglas Fir* (Bash)

*Journey Through the Northern Rainforest* (Pandell)

*A North American Rain Forest Scrapbook* (Wright-Frierson)

## Teacher Resources:

(See appendix)

**SCIENCE CARD**

# Snag a Home

1. Turn to a page in your field notebook and label it "Snag a Home." Record your notes and answers to the questions below on this page.

2. Standing dead trees are called **snags**. Look carefully at the snag at this site and see if you can find evidence that living things are using it, or have used it in the past *(see "Signs of Life..." for hints*). List in your notebook, under the heading, "Life on a Snag," evidence of organisms that you find. If you don't know the name of the evidence you find, draw its picture in your notebook so that you can identify it later.

3. Look at the fallen dead tree at this site and try to discover what living things are using or have used it. List evidences you find in your notebook under the heading "Life on a Fallen Tree." If you don't know the name of the evidence, draw its picture in your notebook so you can identify it later.

4. Much of the sunlight energy which a tree stores through **photosynthesis** is stored in the wood of the tree trunk. Is this energy lost, or is it used by other living things after the tree dies?

5. Many of the minerals that a tree takes up from the soil are stored in its trunk. Look at the fallen dead trees in this area carefully. What evidence do you see that suggests the minerals in tree trunks are returned to the soil?

6. Nurses are people who help other people. Why do you think fallen dead trees are often called "nurse trees"?

***Signs of Life on a Dead Tree***

MICROSCOPIC ORGANISMS: Look for rotten and crumbly wood or slimy coatings on any part of the tree.

FUNGI: Examine mushrooms, shelf fungi, fuzz or furry coatings on any part of the tree.

PLANTS: Are any small plants growing in cracks?

ANIMALS:

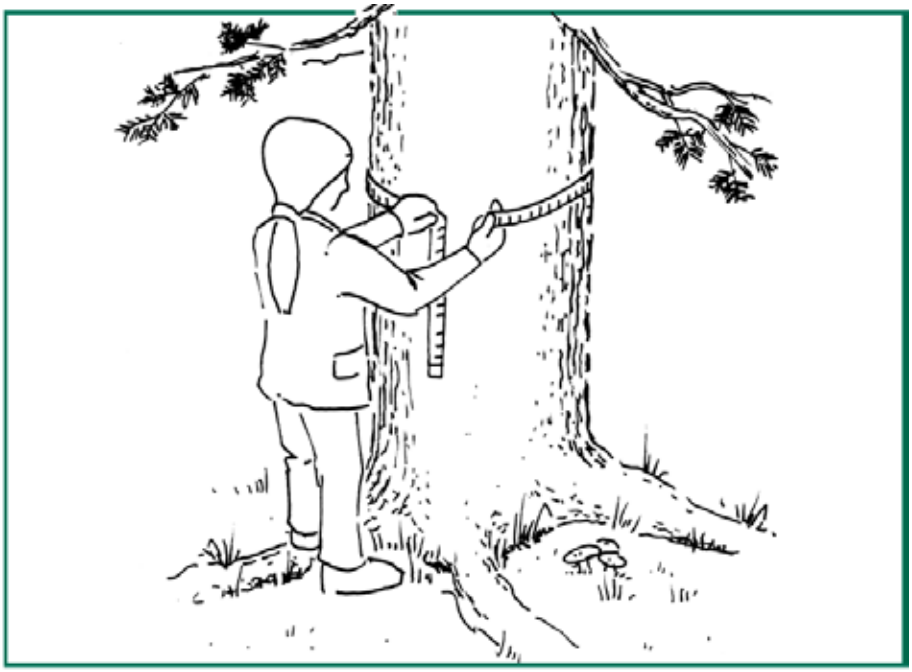
*Invertebrates:* Look closely at any crumbly wood, in the cracks and crevices of the wood, and at any reddish brown sawdust. Carefully remove a few pieces of loose bark or crumbly wood to see if anything is underneath them. Use a hand lens so you won't miss tiny invertebrates. Be sure to replace the wood pieces so that any animals that live there will still have a home.

*Mammals:* Look for hair, droppings, tooth and claw marks on the tree. Look in hollow places where an animal might hide.

*Birds:* Look for drill holes in the bark or a round hole into the trunk. These were likely made by woodpeckers. These birds feed on beetles that eat wood. Look for feathers, whitish droppings, or raptor pellets on or beneath the tree.

# Champion Tree

## 3 EXTENSIONS



*Section 4*
**FOREST ACTIVITIES**

**Grade Level:** 5 - 12

**State Standard:** M A-3

**NGSS:** 5-ESS3-1.

**Subjects:** Math, science

**Skills:** Measuring, computing, observing

**Duration:** 45 minutes

**Group Size:** 2-4

**Setting:** Outdoors

**Vocabulary:** Circumference, crown, height

### Objective:
Students will use math skills to determine the size of trees.

### Teaching Strategy:
Students measure the circumference, height, and crown of trees, and use those measurements in a formula to find the largest tree.

### Complementary Activities:
*OUTDOOR:* "Tree Identification" *in Section 1, Elements that Create Forests. INDOOR/OUTDOOR:* "Tree Leaf Relay" *and* "Tree History – Your History, " *both in Section 1.* "Succession's Path" *and* "Flipbook Succession," *both in this section.*

### Materials:
Copies of "Champion Trees" worksheet *(following pages)*. Pencils, measuring tapes, yardsticks (meter sticks), string, clipboards, tree identification guides or "Alaska Trees" worksheet *(see* "Tree-Leaf Relay" *Section 1*).

### Background:
**See following *Champion Trees Worksheet.***

### Procedure:
1. Review the "Champion Trees" worksheet with the class. Discuss each step and brainstorm some predictions about the investigation. Practice solving one or more examples.

2. Divide the class into small groups of 3-4 students. Equip each group with a tape measure, some string, and a yardstick. Each group will measure three trees. *You may wish to limit each group of students to a separate area for measuring their trees. Alternately, groups may measure the same trees and compare results.*

3. Distribute the worksheets. Demonstrate how to measure tree height, circumference, and crown.

4. Allow groups time to measure three trees and record their data.

5. Students should draw a mural/map of their area and note the location and size of the trees that were measured. Share the map with other students at your school.

6. Identify the species using tree-identification guides or the

Conifer and Broadleaf fact sheets in INSIGHTS *Section 1*.

## Evaluation:

Students write a paragraph or draw a diagram describing the steps that they would take to measure a particular tree.

# EXTENSIONS:

A. **Locate largest local tree.** Give students one week to find the largest tree in their neighborhood, town, or village and collect its measurement data. Compare student findings to determine the champion tree.

B. **Set criteria and locate smallest tree.** Challenge student teams of 2-4 to design a formula and criteria to determine the smallest trees – "mini-champions." Students gather the information and determine the winner.

C. **Survey largest trees on schoolyard.** Students survey the largest trees on the school property (or some other convenient location) to find the champion tree. Award a prize!

## Credits:

Adapted from the American Forest Foundation, "How Big Is Your Tree?" *Project Learning Tree Environmental Education Activity Guide*, Pre K-8, 1993. Adapted with permission of National Wildlife Federation, *Trees are Terrific!* (Ranger Rick's NatureScope), 1992.

## Curriculum Connections:

(See appendix for full citations)

**Books:**

*Grand Trees of America: Our State and Champion Trees* (Jorgenson)

*National Register of Big Trees* (American Forestry Association)

**Website:**

Tree Guide <www.tree-guide.com>

## Teacher Resources:

(See appendix)

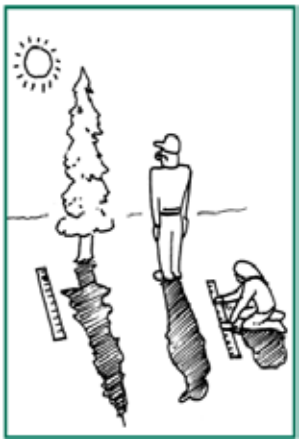
**Alaska's champions include a Sitka spruce that is 185 feet tall, 358 inches in circumference, and has a 50 foot crown spread. Its total point count is 556. The champion Alaska birch has 181 points. It is 67 feet tall, 103 inches around, and has a 42 foot spread.**

# Champion Trees

Measurements of the largest trees of many species are kept by the American Forestry Association. In Alaska, the Cooperative Extension Service publishes a list of the "champion" trees. To find champion trees, foresters measure three aspects of tree size: the **height**, the **circumference** (distance around the trunk), and the average **crown** spread (the distance the branches spread). The numbers are used in a formula to determine the total points awarded a particular tree.

The formula is: ***Point total = height + circumference + 1/4 crown***

For example: 33 Points = 24 feet + 6 inches + 1/4 (12 feet)



**1. Measure the height of the tree**

To determine the height of a tree, measure the length of the tree shadow and the shadow of a stick of known length. A yardstick or a student may be used as a "stick." After measuring the shadow cast by your "stick," measure the tree's shadow by laying a tape measure (or some other measuring device) along the length of the tree's shadow. Use the following formula:

$$\text{TREE HEIGHT} = \frac{\text{length of tree shadow}}{\text{length of stick shadow}} \times \text{length of stick}$$

Height Measurements in feet:

Tree #1 _____ Tree #2 _____ Tree #3 _____

**2. Measure the circumference of the tree**

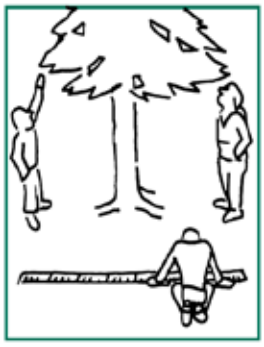
To measure the circumference of a tree, hold one end of a tape measure or yardstick at the base of a tree, and measure up **4 1/2 feet** (the forestry standard). Wrap the measuring tape around the tree at 4 1/2 feet and record this measurement. If the tree is too large to use the measuring tape, use string and measure its length afterward. If there are branches at 4 1/2 feet up or if you are too short to reach that height, measure near there where you can reach.

Circumference measurements in inches:

Tree #1 _____ Tree #2 _____ Tree #3 _____

**3. Measure the tree's crown**:

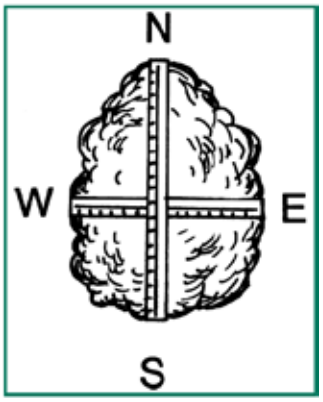
To measure the size of a tree's crown, find the branches which stick out farthest from the main tree trunk. One person should stand under the tip of one of these branches and another person should stand under the tip of the branch on the opposite side of the trunk. A third person should measure the distance between them. Repeat this procedure, but measure the branches at a 90 degree angle from the first measurement. For example, if during the first measurement the twp people stood below branches pointing north and south, the next measurement should be below branches pointing east and west. To find the average crown spread, add the two measurements together and divide by 2.



(Continued on next page)

_____ + _____ ÷ 2 =

First crown measurement + Second Crown measurement (divided by) 2 = _____
Average crown spread




Crown spread measurements in feet:
Tree #1 _____ Tree #2 _____ Tree #3 _____

7. Record tree information for each tree as follows:

Tree # 1
Point total: = height + circumference + 1/4 crown
Height _____feet of height
Circumference: +_____inches of circumference
Average crown spread feet x 1/4 +_____ adjusted crown
=_____ Point total Tree # 1

Tree # 2
Point total: = height + circumference + 1/4 crown
Height _____feet of height
Circumference: +_____inches of circumference
Average crown spread feet x 1/4 +_____ adjusted crown
=_____ Point total Tree # 2

Tree # 3
Point total: = height + circumference + 1/4 crown
Height _____feet of height
Circumference: +_____inches of circumference
Average crown spread feet x 1/4 +_____ adjusted crown
=_____ Point total Tree # 3

**Record the point totals for each of your trees:**

Tree #1 _____ Tree #2 _____ Tree #3 _____

# Champion Trees