Junior Foresters: How Humans Steward the Trees and the Land
By Criqui and Emily

This curriculum is written for Wild Society's afterschool program at Port gamble Forest Heritage Park. Students will attend 3 hours one afternoon a week for 4 weeks.

Anchor Event: Cutting down a tree in an overstocked forest stand.

Main Question: How will cutting down this tree impact this forest?

Model (see attached):

- *Before:* Overstocked stand
- *During:* Trees are cut down in the middle
- *After:* 50 years after the selective clearing

Gapless Explanatory Model:

Throughout history humans have used many methods to manage forests that they lived near and in. Many of the methods involve increasing resources for human consumptions, at varying levels of sustainability. In the United States, clear cutting became a popular forest management practice over the last couple of centuries. Clear cutting involves removing all of the trees in a forest and replanting a monoculture of Douglas Fir trees or some other species. These methods have served not only to maximize product and profit, but also to streamline the extraction process by making the landscape more predictable and controlled.

Many forests throughout Washington, including Port Gamble Forest Heritage Park, are overcrowded with monoculture Douglas Firs stands. Monoculture forests do not mimic the biodiversity or natural progression of successional stages that typically exist within a healthy forest ecosystem. This has led to

NGSS Standards:

(1) ESS3.A: Natural Resources

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

(2) LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on— for example, water purification and recycling.

(3)LS2.C: Ecosystem Dynamics, Functioning, and Resilience

efforts in selective thinning and replanting a diversity of plants to replenish the ecosystem and sustain a healthy forest.

Ecosystems are complex and interdependent webs of life. The individual organisms and species that exist within ecosystems rely upon one another in order to survive. When one species dominates an ecosystem, it monopolizes the available resources and limits the success of other organisms. Ecosystems that have greater biodiversity are typically more balanced and resilient than ecosystems with fewer numbers of species.

In the case of a monoculture douglas fir forest, the stand monopolizes light, space, and soil nutrients. Individual Douglas Fir trees crowd each other and limit the amount of sunlight their leaves have access to. This can cause trunks to become tall and thin as they shed their lower branches prematurely to focus on the higher branches that have access to light. The limited understory lights also prevent smaller shrubs, grasses, and saplings from growing and reproducing. In addition, when all of the trees in a stand are the same age there are fewer instances of trees dying, falling, decaying. This limits nutrient cycling, nurse logs, and habitat from downed wood.

Modern forestry practices have developed methods to selectively cut or thin an overcrowded stand in order to reduce intra-species competition and promote ecosystem biodiversity. Selective thinning can increase forest heterogeneity by creating space to let light in, providing downed wood, and spaces for other species to grow. There is a cascading effect of changes that occur when a tree is removed in an overstocked stand. Cutting down a tree will directly and indirectly impact many species and individuals within an ecosystem over a series of months, years, decades, and sometimes centuries.

After selective cutting, surviving trees nearby fallen logs have less competition for limited resources within the ecosystem. There are open spaces in forest canopies where sunlight can penetrate and reach the understory. Shrub and

- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

(4) ESS3.C: Human Impacts on Earth Systems

- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3), (MS-ESS3-4)

Broad Unit Goals:

1. Understand what forestry is and why it is important
2. Explore what human relationships with the land can look like
3. Answer the question, "How are different parts of a forest connected?"

sapling seeds within the soil, lying in wait for the right conditions, now grow and create new food sources and habitat. These new habitats, along with newly created tree stumps, encourage smaller animals (insects, arachnids, etc.) to make their homes in the ecosystem. Increased tiny critter diversity will provide niches for insectivores within the forest. Once many species gain a foothold within this ecosystem then conditions are created for even more species to move in, including trees other than Douglas Fir. These changes resemble successional stages that occur in forests that develop with no or different types of human intervention. These and many other direct and indirect effects turn a formerly overcrowded Douglas Fir stand into a biodiverse forest ecosystem within a matter of decades.	**<u>Core Practices</u>** 1. Eliciting student ideas: Lesson 1 2. Supporting changes in thinking: Lessons 3 and 4 3. Pressing for evidence based explanations: Lesson 2

Day One	Day Two	Day Three	Day Four
Daily Objective(s) - Get to know some of the tree species, especially Douglas Fir - Visit the three forest types: thinned, overstock, clear cut - explore succession **Type of Activity/Reading** ➔ "interview" different tree individuals: old stump, individual in an overstocked stand,	**Daily Objective(s)** - understand biodiversity - consider why/how a diverse forest is healthier - Consider how humans can play a role in forest management **Type of Activity/Reading** ➔ biodiversity investigation: compare the number of species	**Daily Objective(s)** - Imagine the multitude of ways that humans can and have lived in relationship with land - Answer "How are different biotic and abiotic parts of a forest connected" **Type of Activity/Reading** ➔ Tree limited resources activity	**Daily Objective(s)** - Model the interactions of biotic and abiotic factors within a forest ecosystem - Utilize evidence to support claims about the health of this forest **Type of Activity/Reading** ➔ Revise models ➔ Visit tree that has been cut down. What happens to this forest now?

baby tree in a clear cut ➔ Meet a Tree ➔ Increment boring: how do the ages differ across forest types? ➔ Successional Stages lesson? **Assessing student thinking:** ● model before, during, after of cutting down a tree in the three forest types- provide templates with tree density and question prompts	across the three forest types ➔ plant native plants- where and how will they be most successful? **Assessing student thinking:** ● Post investigation reflection and discussion: what does the data mean?	➔ Human-Forest Relationship Mindmap ➔ Forestry Practice E1T1 ➔ Conservation agency deciding what to do with the forest **Assessing student thinking:** ● Mindmap ● Evidence used to support decisions in conservation agency activity.	(maybe this is on day 4 instead?) ➔ Plant things. Discussion on how close together plants should be planted and in which type of forest plants should be planted. **Assessing student thinking** ● Finished models ● Predict what this clearing might look like in 50 years? ● Apply knowledge by making claims as to where saplings should be planted.

<u>7 Key Elementars</u>

1. Anchoring Event

Students will experience the anchor event when a tree is cut down near a tree they have connected with. This will guide them in thinking about the main question, how will cutting down this tree impact this forest? Students will consider how thinning an overstocked Douglas Fir stand might positively and negatively impact the surrounding forest.

2. Student Knowledge is treated as resource

Students' knowledge is treated as a resource by utilizing it in the initial modeling. The models serve as a way to assess student thinking and build on it in subsequent weeks. Students are engaged in discussion each week using the think, pair, share method, so that they can share knowledge and build on each other's ideas.

3. Students use science to develop explanations/models

Students will construct models during the first and last week of the program. Using their skills of scientific observation, their prior knowledge, and knowledge learned during the program, they will draw and write what is happening before, during and after (50 years) the thinning of an overstocked stand.

4. Student Talk

Students will have many opportunities to share and build upon each others' ideas during several lessons throughout the course including biodiversity initial discussion, biodiversity investigation reflection, conservation agency activity, and sapling planting student debate. Discussion norms will be established early on in the course to ensure students understand "the rules of the game". Students will engage in several registers throughout the course when using talk in different contexts (think, pair, share vs. class debate).

5. Scaffolds Provided to support student participation/writing/talk

Several scaffolds and specialized tools will be included through the course to support students' ability to participate in class. This includes example interview questions during the meet a tree activity and the investigation data charts during the biodiversity investigation activities. Scaffolds will be utilized in tandem with the Gradual Release of Responsibility Model to support students growth in the classroom.

6. Student thinking made visible

There will be many opportunities for student thinking to be visible, both through class discussion and through model making. Once initial and final models have been created they will be presented to the group and students will have opportunities to share to visually and verbally share their reasoning. During class discussions and debates related to biodiversity, students will have opportunities to support their ideas with evidence to the whole group.

7. Lessons built on big science ideas

In the final concluding class for this course learners will act as real life foresters and utilize the knowledge they've built throughout the course in order to collaboratively decide where would be the most ideal location to plant native shrubs. This type of reasoning requires incorporation of big ecological science ideas related to biodiversity and competition for resources.

Junior Foresters Curriculum

Wild Society and Kitsap County Parks Collaboration

Written By: Emily Morgan and Christopher Criqui

Location: Port Gamble Heritage Forest Park

NGSS Standards:

- ESS3.A: Natural Resources: Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)
- LS4.D: Biodiversity and Humans: Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on— for example, water purification and recycling.
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience: Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)
- ESS3.C: Human Impacts on Earth Systems: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3), (MS-ESS3-4)

Unit Goals:

1. Understand what forestry is and why it is important
2. Explore what human relationships with the land can look like
3. Answer the question, "How are different parts of a forest connected?"

Lesson 1: Meet the Trees

Learning Objectives

- Elicit student ideas about forest health, selective thinning, and biodiversity
- Practice modeling cutting a tree in a thinned, overstocked stand
- Understand that there are 4 different forest stand types that we will identify and explore; diverse, clear cut, overstocked, thinned

AST Core Practice
Eliciting student ideas.

Supplies Needed

- Tree interview cards
- Forest stand type cards
- Forest type images
- Printed models on 11X13

Activity: Hiking to the Four Forest Types and Tree interviews

1. Plan a hiking route through the park that includes all 4 forest types: Diverse, overstocked monoculture, thinned monoculture, and clear cut
2. At the first forest type, show a laminated card model of the forest type:
    a. Ask students to think for 2 minutes what they know or notice about the forest type
    b. Have students turn and talk with a partner to share their thinking
    c. With the whole group, have students share out what they or their partner know about the forest type and any questions they have.
        i. Prompt Students to expand on their thinking by asking questions like:
            1. Can you say more about that?
            2. I hear you say _____, is that what you mean?
            3. Student A, can you add on to what Student B is saying?

    d. Write down the student observations and questions on the model forest type card.
3. Play "'Meet a Tree!"
4. Have the students pick a tree that is representative of the forest type that they would like to interview (ie. a stump in a clear cut).
    a. Help the students come up with a list of interview questions. GRRM
    b. The instructor hides behind the tree to be the "voice of the tree."
    c. Students ask the tree questions to learn more about its history and what it knows
5. Ask the students if they would like to add anything to the forest model, something they learned from interviewing the trees.
6. Repeat in all 4 forest types.
7. Ideally, go to the overstocked stand last to observe a marked tree (tree with a face, let the group name the tree).
    a. Observe the tree and imagine what it would be like if a nearby tree got cut down. Discuss:
        i. What do they notice?
        ii. How would cutting down a tree make them feel?
        iii. How might cutting down a nearby tree affect this tree?
        iv. Why do we cut down trees at all?
8. Initial Modeling
    a. Find a spot where the kids can be comfortable and dry
    b. Show them the initial models.
    c. Ask them to draw or write what they just observed in the *Before* and *During* stages of the model.
    d. Explain that the *After* is a prediction of what that stand will look like in 50 years.
        i. What can they predict about how the forest will be affected by the thinning?
9. Wrap up with a discussion, utilizing think, pair, share:
    a. What is biodiversity? Why is it important?

Student Assessment

Initial modeling (see attached) of before (overstocked planted forest), during (thinning the forest), and after (50 years). Analyze what students included in their models, did they incorporate biotic/abiotic? What symbols did they use? What trends do you notice across models? Which of the models stand out and why?

Lesson 2: Biodiversity Investigation

Learning Objectives

- Understand what biodiversity is and how forest management can affect it
- Create a testable question and make conclusions
- Compare and contrast forest stand type biodiversity

AST Core Practice

Supporting changes in thinking

Supplies Needed

- Circles of rope for quadrats
- Scientific investigation charts
- ID cards/books
- Models from week 1
- Whiteboard/pen for math
- Pencils

Activity

1. Revisit the ecosystem models. Give students a chance to share their models with a partner and then with the larger group.
    a. Help students notice trends across their models.
    b. Ask probing questions to encourage sense making conversations.
    c. Tell the students that they will be revisiting models during the last week of the program to add what they learned.
2. Plan a route for the day that will take the students through 3 of the forest types (must include diverse type)
3. Discuss biodiversity with the students using think, pair, share:

    a. What do they know about biodiversity?
4. At each location, collect data about the number of types of species found in that forest:
    a. Explain to students that a scientific investigation uses testable questions to come to a conclusion.
    b. Use the sentence stem on the investigation sheet to help students construct a testable question about the biodiversity of the forest
        i. What is the relationship between _____ and _____?
        ii. What is the relationship between forest stand type and number of species found?
    c. Have students split into 3 groups and use the loops of rope to mark off 3 separate quadrats; try to choose areas that are representative of the forest type.
    d. Give students 5-10 minutes to tally the number of types of species in their circle. Challenge them to look at multiple levels and beyond the surface level (ie up at the trees, under logs, in bushes, etc).
    e. Record the three numbers (one from each group) in the data chart and calculate the average.
    f. Move to the next forest type and repeat the investigation.

	Forest Type 1	Forest Type 2	Forest Type 3
# of types of species			
# of types of species			
# of types of species			
Average # types of species			

5. Once students have completed their data chart, help students write concluding sentences and a question.
    a. We saw the most types of species in the _____ forest type.
    b. We saw the least types of species in the _____ forest type.
    c. I wonder why _____?
6. Wrap with a discussion using think, pair share:
    a. Why does biodiversity differ across stand types?
    b. How might forest management play a role in biodiversity?

Student Assessment
Concluding sentences. Discussions around understanding biodiversity, forest health, and comparing the forest types.

Lesson 3: Historical Stewardship

Learning Objectives:
- Understand that organisms need resources in order to survive and that there are limited resources that exist within an ecosystem
- Imagine the multitude of ways that humans can and have lived in relationship with land
- Utilize forestry knowledge to engage in discussion around how to manage forests

AST Core Practice
Supporting changes in thinking

Supplies Needed
- Resource cards
- Butcher Paper
- Markers
- Pencils
- Stakeholder Guide for Conservation Agency Discussion
- Individual Paper
- Clipboards

- Forestry tools

Fire ecology?

Activity

1. Tree Limited Resources Game
    a. In this game, students will take on the role of trees within an overcrowded Douglas Fir stand. Have students stand in a clump with each student about 6 feet apart.
    b. Instructors explain that they are Nature and have resources (represented as mini resource cards that say water or air or sunlight) that trees need in order to survive.
    c. Once the game begins instructors will walk amongst student and throw resources into the air. Students must grab the resource cards in order for their tree to use the resources, but since they are trees they cannot move their feet and must stay rooted in their spot.
    d. If trees get enough resources, they grow. If trees don't get enough sunlight or water they become stunted. If trees get no resources, they die. After each round 50 years pass and another round is played. This continues until the clearing has been thinned of some trees and there are enough resources for each tree.
    e. Afterward reflect on what happened within the forest
2. Forest Relationship Mindmap
    a. Students will draw and write all of the different ways they can imagine humans might be in relationship with forests on a piece of butcher paper. This can include ways that individuals might interact with a forest as well as ways that cultures and societies have interacted with forests.
3. Forestry E1T1
    a. Each student will have the opportunity to become an expert on a type of forest management practice in order and teach about this practice to their peers.
    b. One instructor will walk along the trail with student #1 until they find an appropriate teaching spot. Instructor will ask student #1 to make

observations about the organism and share anything they already know. Then instructor will share more information about forestry method #1 with student #1 and give them the E1T1 card.

c. Once student feels ready, instructor will go further along the trail and the second instructor will send student #2 to student #1. Student #1 will teacher Student #2 about forestry method #1. After this lesson is complete student #2 will come to instructor #1 to learn about forestry method #2 while student #3 goes to student #1 to learn about forestry method #1. This continues until each student has taught all other students about their organism (refer to gif for visual representation.
d. Forestry practices included
    i. Clear cutting
    ii. Overstocked stand
    iii. Selective Cutting
    iv. Selective Burning
    v. Replanting
    vi. Harvesting/Propagating
e. Reflection at the conclusion to discuss overall themes within forestry methods and how it felt to be a teacher.

4. Revisit Mindmap
    a. Add any new ideas that were developed during the E1T1 to Mindmap

5. Conservation Agency
    a. Now that we know many different methods related to interacting with forests, we are going to act as a community of foresters who are in charge of deciding what we'll do with a particular forest on the Kitsap Peninsula whose deed was just purchased.
    b. This forest is an overstocked stand, planted primarily with Douglas Fir. The trees are about 70 years old and planted about 6 feet apart. There are 200 acres of land in this forest with several trails going throughout.
        i. Some nature advocacy groups want no development or evidence of human impact so as to create the impression that the ecosystem is pristine.

ii. Some developers want it to be clearcut to make room for some new apartment buildings and parks for residents to enjoy.
iii. A lumber company wants to employ local lumberjacks, selectively cut the forest and, sell the lumber for profit.

c. In either 1 large group or 2-3 smaller groups. Come up with a plan on what you want to do with the forest and have evidence to support what you are going to do.

Student Assessment

- Mindmap before and after E1T1
- Evidence used to support claim for Conservation Agency Plans

Lesson 4: It's All Connected

Learning Objectives

- Model the interactions of biotic and abiotic factors within a forest ecosystem
- Utilize evidence to support claims about the health of this forest
- Embody the role of steward and make decisions about how humans will impact an ecosystem

AST Core Practice

Supporting changes in thinking

Supplies Needed

- Tree interview cards
- Forest stand type cards
- Forest type images
- Fresh printed models on 11X13
- Printed models/student work from Lesson 1
- Felled tree

Activity

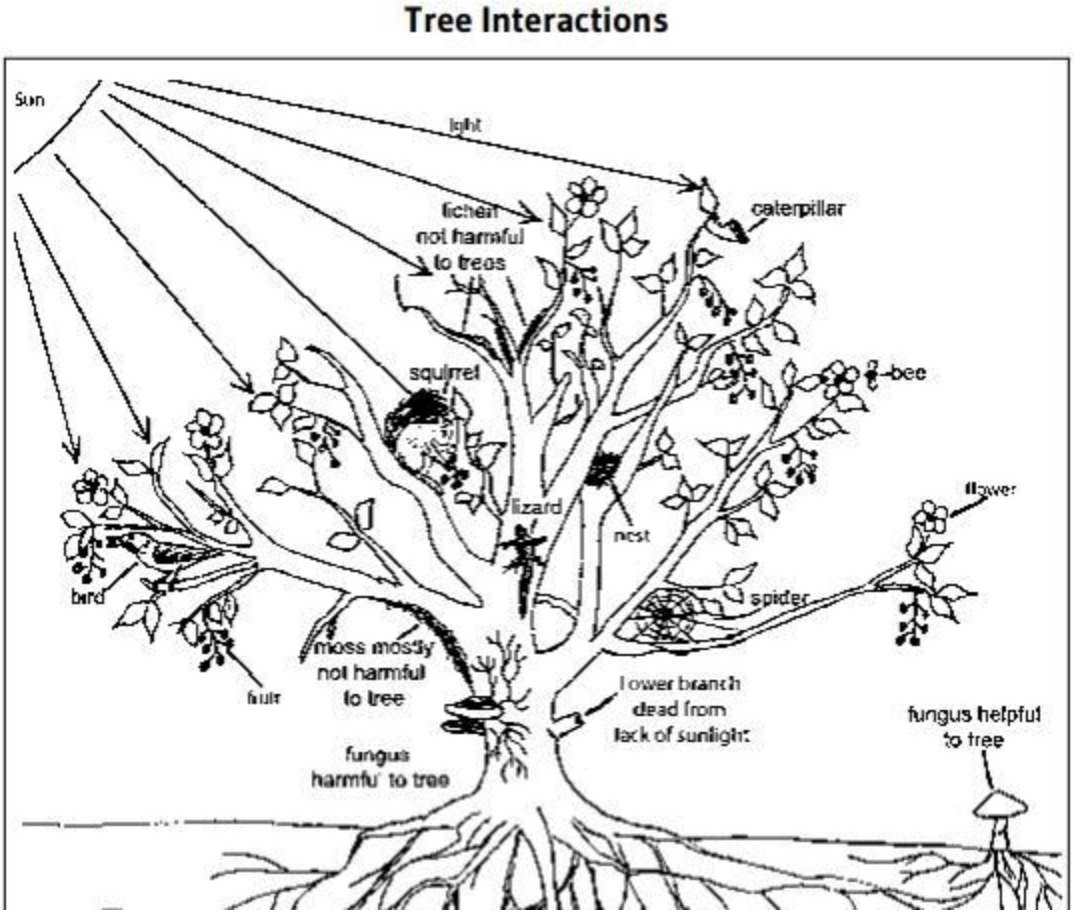
1. Hike to felled tree

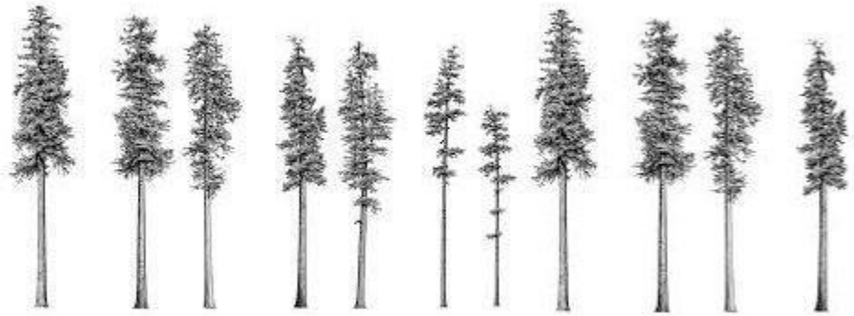
2. Introduce group to felled tree
    a. Remind students of the tree nearby that they met in Lesson 1.
    b. Ask students to consider and share out how either tree (the felled one or the still standing one) might feel
    c. Interviews for felled trees or Groot
3. Analyze ecosystem surrounding felled tree
    a. Students should use senses to make observations about the area around the felled tree.
    b. Note observations white board
    c. Ask students to consider how this felled tree might impact available resources within this ecosystem
4. Revisit models
    a. Using their initial models as a starting point, students will flesh out a summative model with knowledge constructed throughout the month of lessons.
    b. Question they are answering is “How might this tree falling down impact the forest?” Before, during, and after.
    c. Feel free to include bubbles to show what is happening up close in any parts of the model.
    d. Wrap up
    e. Presentation of models
5. Student Debate on where to plant saplings and shrubs
    a. Inform students that now that we understand a little bit more about how forests work, we will get a chance to practice being stewards of this forest. People have been interacting with this forest since time immemorial, and we are going to be a part of that history.
    b. We have 10 saplings/shrubs that the park service wants to be planted where they will grow to support the biodiversity of the forest. We are now going to have a debate about where we should plant these saplings.
    c. Pair and Share with a partner about where you think we should plant these saplings and make sure to provide evidence to support your claim. Feel free to reference your model if you think it might support your ideas.

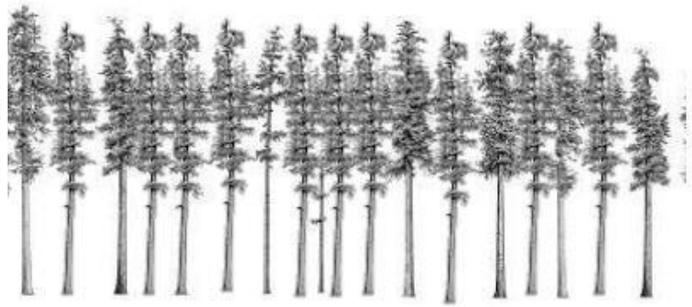
d. Whole group discussion on where saplings should be planted. Encourage students to build on and respectfully challenge others' ideas.

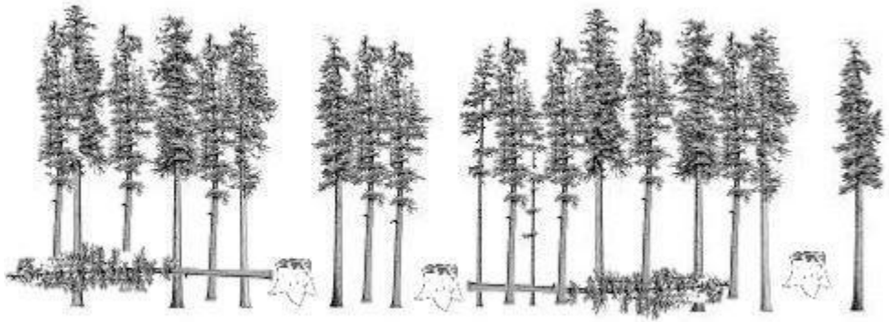
Student Assessment

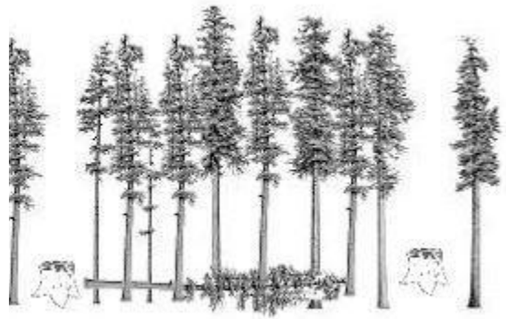
- Summative modelling
- Make note of claim and evidence statements used during sapling debate.

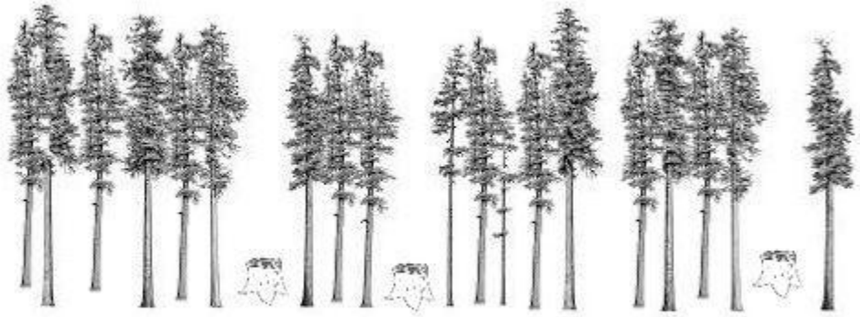
- 

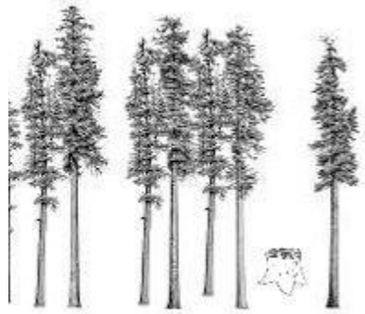












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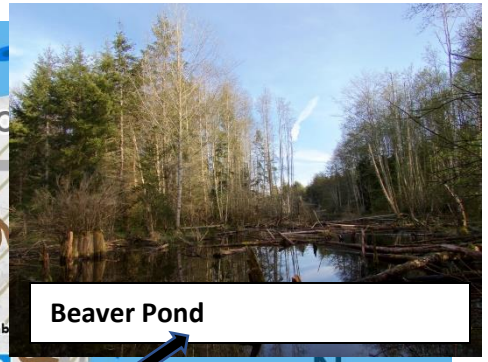
PORT GAMBLE FOREST HERITAGE PARK

Clear cut and over-stocked forest stand



Beaver Pond

Marine Environment/ Rocky Shoreline

Selectively thinned forest stand

Old growth Douglas Fir stumps

- TRAILS
- BEGINNER
- INTERMEDIATE
- ADVANCED
- BIKE ONLY
- HIKE ONLY
- WATER TRAIL
- SERVICE ROAD
- PAVED ROAD
- POPE PROPERTY
- PARK BOUNDRY
- PARKING
- RESCUE MARKER

.25 mile

KITSAP COUNTY 18 57 WASHINGTON

HWY 3

HWY 104

FUTURE RIDE PARK

Port Gamb Trailhead

Bay View Trailhead

TESSA'S

SPRINGS

RANGER

EWOK

DOWNHELL

THE HOOD

SECRET

N

G1100 G1340 G1330 G1320 G1321 G1300 G1430 G1410 G1400 G1420 G1020 G1210

*Trail routes for afterschool program highlighted in green