Woodsmen
Discovery Group

Trees have profoundly influenced the imagination, destiny and lives of humans. Woodsmen will give us an introduction to the signficance of this world.

During the Woodsmen Discovery Group, we will get acquainted with the many varieites of these pleasant living companions. We will explore their forest community, learn about their history and uses, and investigate the animals, birds, and insects that live with them. With recognition and acquaintance should come respect and pleasure.

"Tree qualities, after long communion, come to reside in man.
As stillness enhances sound, so through little things the joy of living expands.
One is aware, lying under trees, of the roots and direction of one's whole being."

- Cedric Wright

***REVISED TO BE FIELD TESTED FOR FALL 09**

Contents

What students learn....	What students do...
Diverse human perspective on trees	Role-play interest groups
Tree biology, biogeography, photosynthesis	Discuss physiology of trees
How to identify trees in the Montane Life Zone	Investigate local tree species
Tree species	Play tree tag game
Tree diseases and issues	Become a tree detective
Seed dispersal methods/other plants	Search for signs of seeds
How the forest can inspire wonder	Journal in the magic forest
Animal habitat and use of trees	Investigate the 4-story treehouse

All-Day

Papermaking	Create and design raw paper
Sawmill Demonstration	Participate in life of a logger
Tree Life and Reproduction	
Fire Science and Forest Management	Apply fire mitigation skills

Materials: lumber company outfits, tree detective police reports, shovel, soil thermometers, tree identification sheet copies, pencils, journals, blender, screens, paper for paper-making

Woodsmen for Teachers and Staff

Colorado State Standards Met

Setting the Role	E/LA4, H3,4,5, G2,4
Tree Biology	S3
Tree Identification Study	S6, G6, A3
Tree Tag	M4,5, S1,3,6, G6, A1,2,3
Tree Detectives	E/LA4, M2,6, S1,3,5, H3,4
Seed Dispersal	
Magic Forest	E/LA2, H5, G5,6
4-Story Treehouse	E/LA4, M3, S1,2,3,4,6, G2,3,5,6
Fire Science and Management	M2,3,6, S3,5,6, H3,4, 5, G2,3,4,5,6
Concluding Discussion	E/LA 2,4, M2,3, S1,3,5,6, H3,4, G2,3,4,5,6
All-Day	
Papermaking	M2, S1,2,4,5, H4,5, G3,4,6
Sawmill Demonstration	E/LA4, M2, S5,6, H2,3,4,5, G2,3,4,6, A1,2,4
Tree Life	E/LA4, M1,2,6, H2,3,4,5, G6
Reproduction Game	M1,2,3,4,5,6, S1,2,3,5, H4, G4,5

Students in Woodsmen should complete the unit with an understanding of our interdependence with trees. Woodsmen should also begin to understand the basic concepts of tree and plant reproduction, age, succession, photosynthesis, cycles and interrelationships. As a result of these understandings, students should gain positive attitudes toward the use of renewable resources and respect for trees as important parts of life on Earth. There are many activities in Woodsmen, designed to keep the unit exciting and interesting through games and active discovery.

Students will benefit from maintaining the small interest groups developed while staff set the role. During transitions, while walking from activity to activity, encourage students to think about a question from the perspective of their interest group. This will keep students focused and more engaged through the entirety of the discovery group.

Setting the Role

Students will: 1. Adopt a diverse perspective to analyze the forest.
2. Persuade other cooperative learning groups of their point of view and conclusions about the use of trees

Approx. Time: 15 minutes

Thematic Introduction

After roll has been taken, a high school counselor playing a wealthy logger from a prominent timber producing region (the northwest, southeast, Minnesota, ect…) suddenly appears with tree-cross sections and informs the group that after conducting a survey of the forests at High Trails, it is apparent that millions of dollars that can be made from a property-wide timber sale. For all intensive purposes the wood is as good as gold. Before the logger can finish his sales pitch, the HT staff member, playing an obscure, disheveled, 18th century British scientist (or any other nationality/perhaps someone from another planet) appears marveling at a pinecone and other tree parts. The scientist explains that they are on a research expedition commissioned by the queen with the goal of studying CO tree species that have been previously un-researched. Grudgingly, the scientist acknowledges that they are aware that multiple forestry interests are present in the group. Among them are four distinct camps led by high school counselors (each dressing the part): the loggers, ranchers, tree-huggers, and the forest ecologists.

The HT staff member divides the students into groups first on a volunteer basis (ex. Which scoundrels are the loggers? Who are the happy-go-lucky tree-huggers?) and then (re)distributes the remaining students to create equal groups. Once students are situated, the HT staff will explain that each group values forests differently depending upon their worldviews or occupations. For example the tree-huggers may value trees for aesthetic and environmental reasons (habitat, O2 production, carbon storage), whereas the loggers see forests solely as a means of producing wood products for profit. The ranchers value trees for highly practical purposes. They provide habitat for wildlife, timber for fences, furniture, and shelter, and perhaps even food. The forest ecologist see forests as their laboratory in which they can study species interactions, biogeochemical exchanges with the atmosphere, develop new medications, and learn how to mimic plant photosynthesis in order to make energy for human use.

After the brief value discussion, encourage groups to brainstorm additional ideas about why they may value trees as the HT staff leads everyone to a mixed conifer/aspen forest northwest of the lodge (directly across from Sunday Rocks). During the hike, encourage high school counselors to actively engage the students in brainstorming and inspire their group to become loggers, tree-huggers, ranchers, or scientists. Allow the hike to meander through the forest and after 3-5 minutes, arrive at an opening suitable for group discussion. Once everyone is seated, review the results of individual group value discussions and transition into a brief overview of tree physiology and biogeography.

Tree Biology

Students will: 1. Analyze the parts and functions of trees.
2. Understand the photosynthetic process by becoming part of the equation.
Approx. Time: 15 minutes

Tree Physiology: Parts and Functions

With the students seated in their groups, begin a discussion on tree life processes. What resources do trees need to grow? How do they extract water, nutrients, and solar energy from their environment? How do they produce enough energy to maintain their metabolic processes? How do they reproduce and combat disease/pests? Use this discussion to segway into an informal overview of pertinent tree parts as students share ideas. For example, yes, trees need water and nutrients to survive, but how do they get it?

Roots: In addition to providing structural support, roots play an essential role in the absorption and transport of waterand mineral nutrients. Mutalistic mycorrhizal associations further enhance the assimilation of water/nutrients by increasing root surface area.

Stem: The stem provides support and houses the vascular system of the tree. The vascular system consists of xylem cells (living wood) and phloem cells (bark). The xylem transports water and inorganic nutrients throughout the plant, while the phloem cells transport organic nutrients, primarily sucrose. In temperate and boreal regions with distinct seasonality, tree growth is initiated and terminated by seasonal climate variability. This leads to the creation of annual growth rings that are produced concentrically around the previous years growth ring. Annual rings can be counted to determine tree age and analyzed to reconstruct past climate regimes beyond the scope of instrumental climate data. In alpine climates, tree growth is primarily mediated by growing season temperature and is thus energy limited. Wide rings indicate warm years, whereas narrow rings may indicate cool growing season temperatures or years with persistent snowpack. Consequently tree-ring samples collected from these sites can be used to reconstruct past temperature spanning hundreds of years. Likewise, trees growing in semi-arid environments are moisture limited and can be used as a proxy for developing drought and stream-full reconstructions. Narrow rings indicate drought conditions, while wide rings signal sufficient soil moisture to provide favorable conditions for tree growth. Furthermore tree-rings preserve scars from low intensity wildfires and can be used to reconstruct precisely dated paleo-fire frequency.

Leaves: Leaves are specialized plant organs that convert radiant solar insolation into chemical energy stored in the bonds of carbohydrates. This process is called **photosynthesis** and is the most critical process for the existence for life on earth as it produces the primary source of oxygen in the atmosphere. Each day plants capture and store thousands of times more energy than humans use in their homes, schools, factories, automobiles, and all other uses combined. The reaction:

$6H_2O + 6\ CO_2 - \text{Sunlight} = C_6H_{12}O_6 + 6\ O_2$

The products of this reaction are diatomic oxygen (released into the atmosphere as a byproduct) and sugar, which is used to maintain metabolic processes. Fixed carbon dioxide that is not used in respiration can be further synthesized into more complex carbohydrates and incorporated into the formation of root, leaf, and wood structures (cellulose). The carbon stored in the woody biomass of forests is important in mitigating potentially dangerous climate change.

The Photosynthesis Game, a quest to produce sugar.

Create four sets decorative note cards illustrating the five components of the photosynthesis reaction; carbon dioxide, water, sunlight, sugar, and oxygen. Randomly distribute the cards to the students, making sure that complete sugars can be made. Once all the cards have been distributed, instruct the students to partner up with other students who possess different components of the photosynthesis reaction. Each group that successfully presents all the factors of the equation in the correct order will receive a sugar (a marshmallow). It helps to have a copy of the equation written down for students to reference.

Biogeography

Now integrate tree physiology principles into a discussion of biogeography. Biogeography is a way to look at the big picture of the land, the study of the geographic distribution of plant and animal life.

Questions to ask:

Why do certain species grow where they do? Why are trees unable to grow in some areas (meadows, tree-line, the north pole)?

Lead students into a discussion of geographic factors that promote or inhibit tree growth:

1. Micro-climates created by topography
2. Orographic effects (rain shadows)
3. Elevation (use tree-line on Pikes Peak as an example)
4. Latitude (discuss the how global patterns of ecosystem types and distribution change with latitude (ie)tropical, temperate, boreal, tundra).
5. Soil type (parent material, pH, organic material, porosity, water capacity).
6. Slope aspect (contrast the differences in tree density and species composition between the northeast facing slope that the students are on, vs. the south facing slope of Little Blue on the other side of the meadow). Have students take soil temperature measurements on a variety of different slopes to illustrate differences in soil temperature.

Climatic factors…
7. Temperature
8. Precipitation
9. Wind

Disturbance factors...
10. Fire frequency
11. Insects
12. Logging
13. Herbivory
14. Disease

Tree Identification and Life History

Students will: 1. Closely study one specific tree species and its life history.
2. Present findings to the group.
Approx. Time: 25 minutes

Tree Identification and Life History Study

After concluding the biogeography discussion, the HT staff should remind the students that they were sent to CO to collect data for the queen. Because of the enormity of the task, the student groups should be commissioned to help study the dominate tree species at HT; Ponderosa Pine, Douglas Fir, Aspen, and Blue Spruce. Assign each group a species to study in the surrounding area and have them complete a Tree Identification and Life History form using data collected from their assigned tree. While students are researching their trees, the HT staff member should float between groups helping to determine slope aspect, analyze mounted tree cores, study soil profiles, ect. Once groups have completed the form, take a tour to all the trees studied and have each group give a presentation of their findings.

Tree Identification and Life History STUDY:(also found in resources)

Tree Name and Picture:

Slope Aspect (N,S,E,W). How does SLOPE ASPECT EFFECT LIGHT AVAILABILITY, SOIL MOISTURE/Temperature, AND Consequently TREE GROWTH/Species Composition?:

Soil Characteristics and Profile Sketch
(What factors effect soil Composition, Layers, Moisture, Insects?, how does soil influence tree distribution):

Bark Texture and Color (SKETCH A PICTURE AND COLLECT A SAMPLE):

Cones and Seeds (SKETCH A PICTURE AND COLLECT A SAMPLE):

Leaves and Needles (SKETCH A PICTURE AND COLLECT A SAMPLE):

Tree History (scars or disease? wide rings? narrow rings? COMPETETION? CONE PRODUCING?, Estimate Age, diameter and Height):

Aspen

How to Identify:

- most commonly found tree in this area with leaves (decidous)
- bark is white and will leave a white powder in your hand (spf 5)
- leaf stems are flattened and at right angles to the leaf, this is why Aspens 'quake'
- sun-loving trees and cannot grow in shaded areas
- most commonly found in open meadows where they can grow in shallow soil
- If spruce or Douglasfir begin to grow in the protective shade of the Aspen, the Aspen lose the area.

Other important facts:

* Foresters consider the Aspen a 'trash tree' because it has a relatively short lifespan (approx. 100 years) and the fallen trunks clutter the forest. During their first 50 years, Aspen grow rapidly (#" in 5 years). The largest Aspen on record is 75' high and 11'2'' in circumference in Cedar City, Utah.

* One of the largest living organisms is an Aspen grove, as all the root systems are connected.

* Although Aspen do produce a pollen and seeds in the spring, the vast majority of them reproduce by sending new shoots off the roots. In many aspen groves it is porssible to rind the "parent tree" from whose roots all the others grew. Aspen aroots may survuve for many years in the dark forest soil and then pop up again after a fire.

* The black 'eye' scars on the trunks of the Aspen are the remnants of branches which have fallen off because thier sunlight was blocked by upper branches. This is called self-pruning.

* Aspen leaves fall in the autumn not because of the temperature change, but because of the tree's declining activity caused by shortened days. A layer of tissue forms between the leaf twig and leaf stem. As water is cut off from the leaves by the tree, the chlorophyl is not renewed...it breaks down and disappears, revealing the yellow pigment beneath. The cells at the base of the leaf stem disintegrate and the leaves fall. It is possible that Aspen continue to conduct photosynthesis through the winter through their very thin bark.

Ponderosa Pine

How to Identify:

- long (about 3") dark green needles in groups of two or three, bitter to the taste
- sections of the bark flake off like pieces of a jigsaw puzzle
- cracks in the bark smell like chocolate, vanilla or caramel
- found on the dry, south facing slopes

Other important facts:

* The largest Ponderosa on record is 223' high, 21'6" in circumference found in the Sierra's in California. The Ponderosa's here at High Trails are much smaller than many found in the West.

* Ponderosa Pine can withstand drier conditions than most other trees, because their root systems are so vast and powerful they can even break rocks apart to find water. There is mor Ponderosa underground than above ground. Roots are important not just because they gather water and anchor the tree, but also because they transport minerals from the soil that trees need in order to grow. The roots of the Ponderosa are covered by microscopic fungi which help them absorb even more moisture.

* Like all coniferous 'leaves', ponderosa pine needles are well-adapted to surviving through the winter. A single vein runs up the center of the needle to carry water and nutrients (unlike the aspen leaf, which has many veins). The resin of the evergreen acts as an anti-freeze and lowers the freezing point of the needles. The walls of the needles are thick, well adapted to withstanding freezing temperatures.

* The ponderosa cone is the female flower: it contains winged seeds on the cone scales. During the first year, the female flowers develop in small tight cones. These are pollinated in June. The seeds develop inside the cones during winter to be released the following summer. Two years are required for the cone to mature and open. The male structures are on the same tree as the female - they look like tiny pine cones and produce a sulfur yellow pollen in June. These trees, like many plants, must produce a vast number of seeds because the likelihood of a mature seed being pollinated, germinating just below the soil in a favored location, and withstanding it enemies (mistletoe, bark beetle, porcupines) until it too can produce seeds - is very small. The ponderosa seeds have no protective shell to keep them intact in the digestive systems of animals, so the seeds are destroyed by all who eat them.

* The Ute Indians used the inner cambium layer of the Ponderosa as a life source and have scarred trees around High Trails. They would mix this sticky layer with berries to make cakes, waterproof baskets, and also for medicinal purposes.

Douglas Fir

How to Identify:

- short, flat single needles which are soft to the touch ('friendly' fir as opposed to stiff spruce needles)
- branches droop on the bottom and uplift on the top
- cone has 3-pronged plates between scales

Other important facts:

* A Douglasfir cone matures in one season. One Douglasfir can drop 2 million seeds in one year.

* Doulgasfir needs shade to begin growing but is more tolerant of sun later in life. Firs are found intermixed with both Ponderosa and Spruce on north and south slopes.

* The tallest Douglasfir is 250 ft and 700 years old. Because of the huge number of these trees in the Northwest, and because the wood is straight-grained and tough and light but strong, many describe the tree as the "greatest lumber source ever known in the world."

Blue Spruce

How to Identify:

- blue-silver in color
- needles are short, stiff, square and sharp
- cones are 2-5 inches long with soft, paper-like scales, light brown in color found at top of tree
- needs shade to begin growing and is found primarily on cool, shady, north slopes

Other important facts:

* Largest Blue Spruce on record is 126' high and 15'8" in circumference

* The Blue Spruce can better endure moisture loss than the other trees here and is more resistant to winterkill, when the ground is too frozen for other trees to take in water.

* The Blue Spruce has a relatively shallow root system, growing only 8 feet deep even in deep soils. It is susceptible to being blown over by high winds. Growing in a closed stand minimizes wind effects, but when one tree goes, this affects the whole stand.

* Spruce cones shed their winged seeds during late fall or winter. In order to travel any distance, winged seeds must fall from a point that is high enough (like the top f a tree) to allow wind and air currents to catch them. (See if students can keep a spruce seed aloft by blowing on it). Keeping the female cones on the spruce increases its chances for cross fertilization and so produces a healthier new generation.

Tree Tag

This simple game allows student to test their knowledge of tree species. To play, find an open meadow bordered by trees and have the trees be the boundaries of the game. Announce that if you touch certain species of trees (which you will announce) you will be 'safe', but only if you are touching the right tree, and that these 'right' trees will change. The counselors will be it or the judges, or you can choose one student to be 'it'. Mix it up by announcing characteristics of the trees. For example, "find a tree that has a shallow root system and can be blown over in high winds"...students will find and run to a Blue Spruce as the 'safe' tree.

Tree Diseases

Have everyone stand up and pretend to be a tree, with their arms out-stretched as branches, their feet planted like roots (and their eyes shut). As they sway gently in the wind, feeling their roots in the ground and the sun on their leaves, ask them to imagine how trees are like people.

Bark is similar to skin (little nicks and scrateches heal easily enough; bigger injuries can bleed and leave bad scars. If too much skin or bark is destroyed, death results) The main body of a tree, the trunk, contains the vessels which carry water and nutrients upward through the tree (like our blood and circulatory systems). Trees breathe in a way, too. They absorb carbon dioxide and use it in photosynthesis with sunlight, water and chlorophyl and release oxygen as a by-product. Also like people, trees have diseases and can die of malnutrition.

Build a Tree Activity

Build a tree is a fun way to demonstrate how a tree functions. Students take on the roles of different tree parts and learn how they work. Students are put into smaller groups as the activity progresses and take on a 'part' as listed below. No student should have more than one part.

Part 1 - The trunk: 2-3 people stand back to back to be the tree trunk – the strength of the tree that holds the branches and leaves upright.
Part 2 - The taproots: Students sit on the floor (against the trunk) with their legs facing outwards from the base of the trunk (if you have a large group put students close together, otherwise just use 2-3 and spread them out). The taproots add stability and suck up water that is vital to the trees survival and growth.
Part 3 - The lateral roots: Students lie on their backs with their feet against the trunk, growing outwards. They have root hairs (arms and hands) that reach out to suck up water. Students act out this function by waving their arms and hands and making a loud "slurp" noise.
Part 4 - The xylem: Students hold hands around the trunk facing inwards. They bring water up the tree from the roots to the tips by squatting with their hands down low, then standing up to bring their hands above their heads. As they do this they make a "wheeeee" noise for the travelling water.
Part 5 - The phloem: The last group of students form a circle around the xylem to make the phloem. The phloem carries food from the leaves to different parts around the tree. To act this out students wobble their hands in the air to make food and make a "whooo" noise to emphasise the food being transported around the tree.

The rest of the group forms the bark and fends off those creatures wanting to attack the tree while everybody else continues their actions and noises all at once.

Tree Detectives

Students will: 1. Investigate and identify causes of unhealthy forests.
Approx. Time: 25 minutes

Lead the counselor led groups north to the tree graveyard located directly behind Sunday Rocks. Here student groups will be working as detectives to identify crimes committed against an ailing forest and the likely culprits. On the walk over, inform the students that upon the conclusion of the discovery group, they will be conducting a short debate between groups as to whether all the trees at High Trails should be cut down in order to turn a profit. During the walk have the counselors start to work with their groups to formulate the students' positions and arguments for the debate (in accordance with their worldview).

Police Report: A ponderosa Pine is currently under attach by an evil orange-colored invader, disguised as a harmless plant. This thief is stealing food from trees and twisting their branches, then jumping onto other healthy trees to try this trick again. Identify the thief and discover it's methods and spread.

Mistletoe is a brownish orange finger-like protuberance. It is a parasitic plant, growing where the tree bark has be scarred or weakened. Its roots take hold within the cambium of the tree and it lives on the minerals and nutrients which are vital to the tree. Mistletoe is capable of shooting its seeds over 50 ft. and spread easily to other trees. Mistletoe also twists and stunts the tree's growth, ruining it for lumber. Often the only way to stop its spread is to cut down the infected tree.

Police Report: A very hungry mammal has been eating the inner bark of area ponderosas, leaving full branches stripped of bark. Who did it? How do you know? Now determine the extent of the crime: Is it murder? or will the victim survive?

A tree with a lagre portion of its bark removed during certain seasons will literally bleed to death. Porcupines are one of the worst offenders, often killing trees by overeating.

Police Report: A gange of dangerous thugs have been sneaking into trees and eating their cambium layer, cleverly leaving the barkr intact so that their crime can almost go unnoticed. They are small, but potentially deadly. A local bird turned crime-stopper has been helping victims by finding and destroying these whitish colored tree-eaters. Who are these criminals? And who is trying to help? Find evidence of both activities. Will the crim-stopper's efforts end up killing the victim, or helping it?

Bark beetles live under the bark of trees and eat the cambium layer. They are often helpful in decomposing dead trees and returning nutrients to the soil. A living, healthy tree can usually survive their attacks, and birds (like woodpeckers)are often helpful in controlling their spread. Woodpeckers seem to know instinctively how many holes they can put in a trees bark without harming it.

Police Report: One tree in this area has undergone electric shock and survived, another has not been as lucky. Even if they survive the initial jolt, they sometimes die later. Why? Find these victims and examine them closely in order to find the answer.

If lightning does not completely burn a tree, it amy survive, but often in a weakened state. At this point, beetles, mistletoe and animals will sometimes finish off the tree.

Police Report: A tree in our area has been spotted stealing sunlight from an innocent elderly Aspen. Find the victim and explain how you can tell it is losing sunlight. Then locate, question and identify the thief. Is a crime being committed here?

Older Aspens begin to lose their ower branches as sunlight fails to reach these leaves. You can tell where these branches have been by te black eyes which line the Aspen;s trunk. The death of Aspen in the shade of firs or spruce is part of the forests natural life cycle, sometimes called succession. Sometimes there are so many trees growing close together that they cannot all get enough sunlight, water and soil nutrients. By natural thinning processes like this, the remaining trees grow stronger and healthier. Forest managers afoten hurry this process along by selective cutting to help strengthen the forest.

Seed Dispersal + Tree Reproduction Game

Have a bunch of old wool socks students can put on their hands as they walk through the woods, trying to capture seeds. This is how the inventor of velcro came up with his idea...while hiking he noticed certain seeds sticking to his socks. The study of Biomimicry looks a how we as humans can borrow ideas from nature.

See what the students find and point out a Douglas Fir cone before organizing the Tree Reproduction Game. Trees take a long time to grow, and they face stiff odds in trying to begin life. This game demonstrates why trees and many other plants produce such a large number of seeds (or eggs for example, in Salmon reproduction)to reproduce just a few, or only one, tree. Remind the students that the average Douglasfir will produce two million sees in a a single year - and that just here on the ranch there are thousdands of Douglasfir trees. Do they think all the fir seeds eventually grow into seeds?

Here's how to play:

All the students will represent Douglasfir tree seeds.
The counelors will be 'it', representing squirrels, birds, insects and other animals that eat the seeds.
The fir seeds are carried by the wind, and can only run when you say the wind is blowing.
When they are tagged (eaten), they must sit down.
Let them play.
Now announc all fir seeds wearing red have just landed on cement.
green have just fallen into a swamp.
Repeat several times having seeds fall in the shaded, poor soil of the forest, or on a hot south slope.
When there are still a few layers left, have them land where they can germinate, but allow a few counselors to 'eat' the seeds.
At the end of the game, only one or two fir seeds should be allowed to grow into full adult trees.

Fire Mitigation - If you have extra time or are specifically interested in fire science, see the All-Day Activities section of this guide to incorporate fire mitigation content and games.

Magic Forest

Students will: 1. Reflect and write in journals.
Approx. Time: 15 minutes

Take the opportunity for some creative writing and reflection. Walk into a nearby forest as deep as possible, to a place children will recognizeas a magic forest if they sit very quietly and listen for sounds among the trees: rustling of the grass, creaking of limbs, scurryings in upper branches, songs and twitters of birds, swishes of wind through pine needles.

Sit under a tree and look up to see it's arms reaching for the sky. Think about the roots underneath and how far they extend in all directions under the ground. What would it be like to be rooted in one place for hundreds of years, not being able to come in out of the thunder and lightning, icy blizzards, high winds, hail and rain? But remember the good times when the warm sunlight filters through the needles and you feel like stretching and growing.

What about the people these trees have seen in the past hundred years? The Ute Indians, explorers, miners, ranchers, hunters, wood-cutters, and other students. Remember the elk and deer, coyotes and porcupines, rabbits and bunnies in their burrows and the squirrels chasing each other through the neighborhood.

Jot down in your journals a few ideas about the forest today. A poem, or a thought that is your own, maybe a story told by a certain tree, or a description of an animal family who lives here. Add a sketch or drawing, write a song or just take quiet time. This is your time to sit and be part of the life of the forest.

4-Story Treehouse

Students will: 1. Climb 30 feet to the top of a stand of Ponderosa Pine.
2. Review tree physiology concepts.

Approx. Time: 20 minutes

The sight of the treehouse will generate tremendous excitement from the group, so it is a good idea to set some guidelines (see Safety below). Once the group arrives at the tree house, allow the students 5 minutes to explore, making sure that all students have the opportunity to spend time on the fourth floor.

After the students have had some "fun time", assign each group (HS counselor included) to a level in the tree house. Instruct the students that each floor represents a part of a tree. The bottom floor represents the roots, the second floor the stem, the third floor the branches, and the forth floor the leaves. Have each group discuss the importance of each level for the tree and for any other plant or animal that may utilize that floor as habitat or for food. After allowing the students sufficient time for discussion within their groups, have each floor present their function to the other floors. This is an opportunity to have the students reiterate previous discussions about tree physiology and to think about the relationships between trees and other forms of life.

Questions to ask:

How do trees offer housing to animals? Which animals?

How is a tree like a hotel?

- *Basement - water systems, air conditioning and garbage disposal*
- *Lobby - any evidence of animal traffic?*
- *Dining Room - What animals might eat here? What do they eat?*
- *Rooms - Who are the main guests of the hotel?*
- *Penthouse - Who lives on the top floor in the tree canopy?*

Safety:

It is a good idea to send two high school counselors ahead of the group to supervise the first and fourth floors. Basic groundrules for the treehouse should include; no rough-housing, one person on the ladder at a time, no throwing stuff from the treehouse, each floor should have an adult/hs leader to supervise.

Concluding Discussion - The Great Debate

The Big Debate: Should all the trees at High Trails be cut down?

Organize the students into two groups; the loggers and ranchers in one and the forest ecologist and tree-huggers in the other. Give the groups 5 minutes come to a consensus on what position they will argue and then to formulate a brief opening argument, complete with concise, concrete examples on why their position should be honored. Once groups are ready to begin, decide which group will present first by flipping a coin or playing a game of paper-rock-scissors. After each group has delivered their opening arguments, the HT staff, acting as the debate moderator, will pick 2-3 points noted by both sides to offer for counter debate in which both sides will be able to argue back and forth. The HT staff member should conclude the debate by summarizing each sides chief arguments and then encouraging a discussion geared towards reaching a compromise. How can we remove some trees for essential human use while, maximizing forest preservation for the purpose of maintaining wildlife protection and ecosystem services (carbon sequestration, O2 production, soil stabilization, water filtration, etc…).

Other good questions for a closing discussion...

What have you learned today?

Is it wrong for humans to use trees? Could we live without using trees? Is there a right and wrong way to use trees? What is the wrong way? The right way?

What are the results of cutting down all the trees in one large area? Is there a better way to lumber - a way that will allow us to use trees without destroying the forest?

How can each of us help to protect the forests and trees - even in our cities?

If it is apparent that the group will be unable to devote enough focus for a debate, consider playing the elk/wolf game in the meadow in front of Sunday rocks. This will make up for the time that would normally be spent on the debate (10 minutes) as there are some excellent analogies and connections to be made in the debrief of the game.

The Elk-Coyote Game

As a run-across game, it is important to determine the playing field. Once an East and West border are established, use student backpacks and jackets to represent trees in the middle of the playing field. Ask for one or two volunteers to be the Coyotes and the rest of the students will line up at the border as the Elk. The Coyotes job is to hunt Elk. They do this by tagging students as they runacross the playing field, using trees (backpacks, etc...) as safe zones. Elk should only run across on your command. Once tagged, the Elk must sit outside of the playing field. After playing one round, start to slowly take away trees, as the area is being logged or diseased for a variety of reasons. Students will realize it is harder for the Elk to make it safely across without the natural protection of the trees.

Woodsmen All-Day

Papermaking

Students will: 1. Make raw paper from pulp
2. Discuss the use of renewable resources and importance of recycling.
Approx. Time: 30 - 45 minutes

Even though trees are a renewable resource, it can take a lifetime to 'renew' a forest once it has been cut. It takes 17 trees to make a ton of paper - and think how much paper we use everyday. For this reason, it is important that we conserve the wood products we have. One of the best ways to do this is to practice recycling. Recycling is taking waster products (otherwise burned or buried - wasting land and causing air pollution) and turning them back into usable items.

For most of its history, paper existed as a precious and rare commodity. Today, it covers the planet. From the contents of our in-boxes to the currency in our wallets to the containers for our frozen dinners, paper is never far from reach. Global paper use increased more than six-fold over the latter half of the 20th century, and has doubled since the mid-1970s.

About 93 percent of today's paper comes from trees, and paper production is responsible for about a fifth of the total wood harvest worldwide. A sheet of writing paper might contain fibers from hundreds of different trees that have collectively traveled thousands of kilometers from forest to consumer.

Though invented as a tool to communicate, about half the paper in today's consumer society serves another purpose—packaging. This and other rapidly discarded paper now represents a big chunk of the modern waste stream, accounting for roughly 40 percent of the municipal solid waste burden in many industrial countries.

Making the Paper

Paper is made by chopping up wood into chips, then mashing them together with water to make a mushy soup called pulp. This is usually mixed with chemicals and cooked before it is put into a paper-making machine. To recycle paper we can follow a similar process, using mashed up paper with water instead.

1. Place ripped up paper in blender with water. When it is thoroughly blended and liquid, pour it into a flat dish.
2. Pull the screen through the liquid, allowing a thin layer of the pulp to settle onto the stretched screen.
3. Now place the screen and pulp in the sun to dry (usually takes 1-2 hours to dry)

At the Sawmill

Students will: 1. Understand reasons for cutting trees.
2. Assist and observe the process of cutting a tree on a historic sawmill.
Approx. Time: 45 minutes

I. **Discussion:** *Why do we need to cut down trees?*
- Forest Fire, Hayman Burn, mitigation, beetles, healthy forest
- Uses of Trees

II. **Felling the Tree** (if possible)
Why did we choose this tree? Is anything living in it? Are dead trees better than live ones to cut? Can you guess the age of the tree? How would we know? What year was this tree born? What was going on in history (US and World) when this tree was born? DISCUSS SAFETY PRECAUTIONS

III. **Sawmill** - History of Sawmill, tour the mill/planer/edger
Upon arrival at the sawmill, let the students inspect the sawmill for awhile and take a close look at the machinery and engineering behind the milling process.
This sawmill was used in the early and mid-1900's by area ranchers who wanted to be able to make the lumber for their own fences, wagons, buildings, etc... They also sold small quantities of lumber. This sawmill is capable of cutting 5,000 board feet a day, but was probably not used this much. Investigate the pavilion 'rough cut' wood or other scraps around the sawmill.

Questions to ask: *What are uses for the boards?*
Guess how many boards will we get out of tree?
Look closely at old blades…how do teeth work? What if this gets warped?
Why is this one of the most dangerous jobs in the world?
*How is this wood different from wood that you buy at Home Depot? (*Rough vs. finished)

Inspect the sawblade. *Why do you think the teeth come out? How sharp would they have to be? Notice how straight the blade is. What would happen if it were not straight? Show students how the sharpen works.*

The **teeth of the blade** must be kept extremely sharp. If they were not removable, the whole blade would have to be taken off each time a tooth got dull. Teeth that are broken or worn out can be easily replaced. If the blade is not straight, it will 'bind' or get caught up in the log. When this happens the teeth become hotter than the center part of the saw and the blade will warp. This is dangerous because it if continues the blade can break. If the blade becomes warped it has to be hammered straight again by someone who knows how to do it, of which there are only 5-10 experts in the US that can do it. Proper bi-annual maintenance on this mill is also necessary because it is not set on a cement pad. The seasonal heaving of the ground causes misalignment, and can cause problems for the miller running logs through the blade.

Inspect the motor, drive belts, carraige

Have students carry a log using the log carriers

More Questions: *How many of these trees will we need to build one house?*
How can we make sure our forests are not completely destroyed?
What happens with all the sawdust? Are there any uses for it? (go to the pit)
What happens with the slab scrap pieces? What would you do with it?

Fire Mitigation

Students will: 1. Decide which trees should be cut to maintain a healthy forest.
2. Understand how and why forest fires burn.
Approx. Time: 20 minutes

Compare Mitigated (along Hercules) to Non-mitigated Forest
Why is one more healthy?
How do forest fires burn?

Woodsmen Prescribed Thinning Activity

This purpose of this activity is to demonstrate the role of science-based thinning and logging in fire prevention. It also should provide the students with an opportunity to use their newly acquired knowledge of tree damage and defect. The activity can be prefaced with a brief discussion on the preventative timber measures carried out by the U.S. Forest Service, (i.e. a specialist surveys each specific area of timber to determine the extent of thinning required, technicians are employed to carry out the "prescription" based on the instructions, the marked timber sale is marketed to logging companies who log the designated trees after purchasing the sale). Idealistically each part of the process is based on what is best for forest health and growth preservation.

This activity can be used after lunch before heading to the sawmill, or in the instance that the sawmill is not functioning. For each prescription card, choose an appropriate plot of forest.

Prescription 1 requires a heavily wooded area of thick growth with lots of undergrowth, young trees—mostly Doug fir.

Prescription 2 is best conducted in an open area of large ponderosa pine trees.

Prescription 3 necessitates an area of highly defected older growth--look for mistletoe, lightning scars, porcupine damage, knarled branches—and overshadowed but otherwise healthy young growth.

Give each counselor their thinning prescription and show them the area designated. Each group also should have a few feet of neon flagging to tie on "CUT" trees and a tape measure to take the circumference. Based on the prescription card and what they have learned, kids decide which trees should be marked to cut and which should be left as "LEAVE" trees. After each group has finished marking their area, the groups can tour around and explain their plot prescription and how it would be logged.

Tree Life - Respect for the Age of Trees

Students will: 1. Determine climactic and historic patterns by inspecting tree rings.
Approx. Time: 20 minutes

Take a look at the trees around you. *How old do you think they are?*

Now take a look at the trees ready to go into the sawmill (or carry with you the sets of preserved cross sections in the Woodsmen box). Try and count their rings. A narrow, dark ring (representing winter growth) and a wider light ring (summer growth) combine to represent one year in the life of the tree. Compare the size of your tree with the size of the trunk sample and approximate the age of your tree now.
Are the trees here younger or older than you thought?

More questions to ask:

Do the rings tell you anything else? What do you think the weather was like when the ring is thick? Which years did the tree grow the most? What kind of weather would promote good growth? Where do you think trees grow larger and faster?

Historic Intuition of Trees

During which years do you think the farmers around this area had a good crop? Which years were they unable to m ake a living off the land? Which years were good ones for the Witcher Ranch? Can you read human history in tree rings? Think for a moment about the combined ages of the trees that were used to build your home in town. How many years do you think your home represents?

Woodsmen Resources

Tree Identification and Life History STUDY:

Tree Name and Picture:

Slope Aspect (N,S,E,W). How does SLOPE ASPECT EFFECT LIGHT AVAILABILITY, SOIL MOISTURE/Temperature, AND Consequently TREE GROWTH/Species Composition?:

Soil Characteristics and Profile Sketch
(What factors effect soil Composition, Layers, Moisture, Insects?, how does soil influence tree distribution):

Bark Texture and Color (SKETCH A PICTURE AND COLLECT A SAMPLE):

Cones and Seeds (SKETCH A PICTURE AND COLLECT A SAMPLE):

Leaves and Needles (SKETCH A PICTURE AND COLLECT A SAMPLE):

Tree History (scars or disease? wide rings? narrow rings? COMPETETION? CONE PRODUCING?, Estimate Age, diameter and Height):

Measuring Tree Height

Measuring the height of a students favorite tree is a fun, hands on math activity. A trees height has many consequences for its neighboring trees and plants, animals, water, sunlight and soil.

Here are three ways to estimate a tree's height:

Rough Estimate

Working with a partner, measure the height of one person and record. That person then stands straight against the tree. The second person stands at a distance and estimates how many 'heights' of that person make up the tree height. Walk further back and repeat. Switch partners and see if you get a consistent estimate.

Loggers Estimate

Work with a partner. One person stands at a distance from the tree and extends his or her arm to full arm's length. Bracket the tree height between the thumb and forefinger. If the tree is too big, walk further away from the tree. Without changing the distance between the fingers, rotate the hand so the distance runs along the ground from the base of the tree outward. The second student should locate the spot on the ground identified by the first student forefinger. (It is important that the first student keep his or her arm fully extended throughout the exercise.) The distance on the ground equals the height of the tree.

Shadow Estimate

Work with a partner. Measure the height of one person and the measure of his or her shadow. Record. Measure the shadow length of the tree and record. The following proportion can be used to calculate the tree height:

$$\frac{\text{height of tree}}{\text{length of tree shadow}} = \frac{\text{height of person}}{\text{length of person shadow}}$$