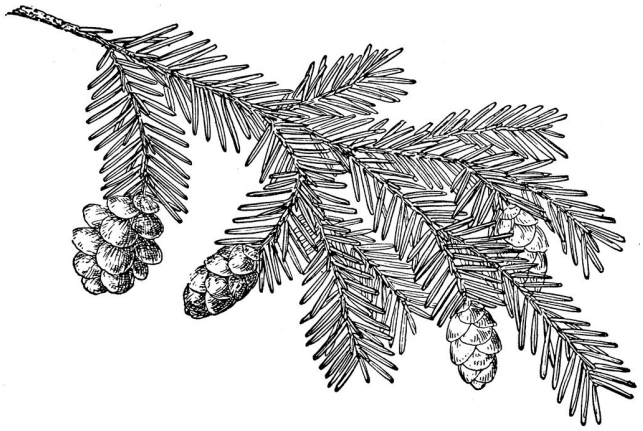
Woodsmen

Trees have profoundly influenced the imagination, destiny and lives of humans. Woodsmen will give us an introduction to the significance of this world. During the Woodsmen Discovery Group, we will get acquainted with the many varieties 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. Trees have a tremendous amount to teach us about our world.



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

High Trails
outdoor education center

Contents

What students learn...	What students do...
Diverse human perspective on trees	Role-play interest groups
Tree biology, bio-geography, 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 tree-house

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All-Day

Paper-making	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

Content Area: Science
Standard: 2. Life Science

- Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species

Content Area: Reading, Writing, and Communicating
Standard: 1. Oral Expression and Listening

- Successful group discussions require planning and participation by all
- Organizing structure to understand and analyze factual information

Content Area: Mathematics
Standard: 3. Data Analysis, Statistics, and Probability

- Solve problems and make decisions that depend on understanding, explaining, and quantifying the variability in data

Content Area: Visual Arts
Standard: 1. Observe and Learn to Comprehend

- The characteristics and expressive features of art and design are used in unique ways to respond to two- and three-dimensional art

Content Area: Physical Education
Standard: 1. Movement Competence & Understanding in Physical Education

- Demonstrate competency in motor skills and movement patterns needed to perform a variety of physical activities

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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.
Approximate Time:	15 minutes

Thematic Introduction

After the roll has been taken, a high school counselor playing a wealthy logger from a prominent timber producing region (the northwest, southeast, or Minnesota region) 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 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, a HT staff member, playing an obscure, disheveled, 18th century British scientist (or any other nationality) appears marveling at a pine cone and other tree parts. The scientist explains that they are on a research expedition commissioned by the queen with the goal of studying Colorado tree species that have been previously gone unresearched. 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, the ranchers, smokejumpers, and the forest ecologists.

The HT staff member divides the students into groups first on a volunteer basis (for example: Which scoundrels are the loggers? Who wants to examine every tree, as the forest ecologists?) 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 world views or occupations. For example, the tree ecologists may value trees for academic and environmental reasons (habitat, O_2 production, carbon storage), whereas 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 smokejumpers see forests as through the eyes of community-protection and forest health - sometimes it is necessary to mitigate and chop down trees to keep a forest healthy, or even let a natural wildfire burn.

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 discussion. Once everyone is seated, review the results of individual group value discussions and transition into a brief overview of tree physiology and bio-geography.

Tree Biology

Students will:	1. Analyze the parts and functions of trees. 2. Understand the photosynthetic process by becoming part of the equation.
Approximate 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 lead 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 them?

Roots: In addition to providing structural support, roots play an essential role in the absorption and transport of water and 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 snow pack. Consequently, tree ring samples collected from these sites can be used to reconstruct past temperatures 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 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.

In the reaction:

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

The products of this reaction are diatomic oxygen (released into the atmosphere as a by-product) 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 of 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.

Bio-geography

Now integrate tree physiology principles into a discussion of bio-geography. Bio-geography 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 shadowing)
3. Elevation (use tree-line on Pikes Peak as an example)
4. Latitude (discuss how the global patterns of ecosystem types and distribution change with latitude (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 and 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.
7. Climatic Factors:
   Temperature
   Precipitation
   Wind

   Disturbance Factors:
   Fire frequency
   Insects
   Logging
   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. 1.
Approximate Time:	25 minutes

Tree Identification and Life History Study

After concluding the bio-geography discussion, the HT staff should remind the students that they were sent to Colorado to collect data for the queen. Because of the enormity of the task, the student groups should be commissioned to help 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 assist groups in determining slope aspect, analyzing mounted tree cores and soil profiles. Once groups have completed the form, take a tour of all the trees studied and have each group give a presentation of their findings.

Tree Identification and Life History Study Form

(Also found in resources)

Tree Identification: Tree Name and Picture

Slope Aspect: (North, South, East, West) How does slope effect LIGHT AVAILABILITY, SOIL MOISTURE and TEMPERATURE, and consequently TREE GROWTH or SPECIES COMPOSITION?

Soil Characteristics and Profile Sketch:
What factors effect soil composition, layers, moisture and 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: Evidence or scars or disease? Wide rings? Narrow rings? Competition? Cone Producing? (Estimate age, diameter and height)

Aspen

How to identify:

- Most commonly found tree in this area with leaves (deciduous)
- Bark is white and will leave a white powder on your hand (spf 5)
- Leaf stems a 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 a Spruce or Fir begin to grow and shade the Aspen, the Aspen will lose the area.

Other important facts about the Aspen:

- Foresters consider the Aspen a "trash tree" because it has a relatively short lifespan for trees. (Approximately 100 years) Their fallen trunks clutter the forest. During their first 50 years, Aspen grow rapidly. (Anywhere from 12-25" per year, depending on soil, drainage, water, fertility, light, and exposure) The largest Aspen on record is 75' high and 11' 2" in circumference found in Cedar City, Utah.

- One of the largest living organisms is an Aspen grove because all the root systems are connected.

- Although Aspen do produce pollen and seeds in the spring, the vast majority of them reproduce by sending new shoots of the roots.

- The "black eye" scars on the trunks of the Aspen are the remnants of branches which have fallen off because their 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 (less sunlight). A layer of tissue forms between the leaf twig and leaf stem. As water is cut off from the leaves by the tree and the chlorophyll is not renewed. The chlorophyll (the green part of the leaf) 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 the Aspen continue to conduct photosynthesis through the winter through their very thin bark.

- The light, soft, low-strength wood of an aspen tree is now used to make plywood, particleboard, pallets, crates, excelsior (fine wood shavings), matches and pulp for paper. The wood does not splinter, so it can make good sauna benches and playground equipment.

Ponderosa Pine

How to identify:

- Long (about 3”), dark 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 dry, south-facing slopes

Other important facts about the Ponderosa Pine:

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

- The Ponderosa Pine can withstand drier conditions than most other trees. Their root systems are so vast and powerful they can even break rocks apart to find water. There is more of the Ponderosa tree 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 the trees need in order to grow. The roots of the Ponderosa Pine are covered by microscopic fungi which help them absorb even more moisture.

- Like all coniferous trees, the Ponderosa Pine “leaves” or 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 and well adapted to withstanding freezing temperatures.

- The Ponderosa Pine 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 cone. 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 favorable location, and withstanding its enemies (mistletoe, bark beetles, porcupines) until it can produce seeds is very small. The Ponderosa Pine seeds have no protective shell to keep them intact in the digestive system of animals, so the seeds are destroyed by all who eat them.

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

Douglas Fir

How to identify:

- Short, flat single needles which are soft to the touch. (The "friendly fir" as opposed to the stiff, sharp needles of the spruce.
- Branches droop on the bottom and uplift on the top.
- The cones have 3-pronged plates between the scales.

Other important facts about the Douglas Fir:

- A Douglas Fir cone matures in one season. One Douglas Fir can drop 2 million seeds in one year.

- The Douglas Fir needs shade to begin growing but is more tolerant of sun as it matures. These firs are found inter-mixed with both the Ponderosa Pine and the Blue Spruce.

- The tallest Douglas Fir is 250' and 700 years old. Because of the enormous number of these trees and because the wood is straight-grained and light, yet tough and strong, many describe this tree as the "greatest lumber source ever known in the world."

- Many animals in the forest feed off of the needles of the Douglas Fir. Numerous species of birds as well as rabbits, elk, deer, beaver, and chipmunks rely on the needles as a staple of their diet. After scraping off the bark, bears will eat the sap layer of the tree.
- Because of the thick bark of mature Douglas Fir trees, it is often able to survive forest fires with the only damage being blackened bark.
- Douglas Fir trees are a useful aid in preventing soil erosion when grown in the right spots.
- Clay can be dangerous to the health of a Douglas-Fir. Because it contains a lot of moisture, it can cause the tree's roots to rot.
- The main pests that the Douglas Fir is susceptible to include aphids, scale beetles and bark beetles.
- In many parts of the United States, Douglas Fir trees are used as Christmas Trees.

Blue Spruce

How to identify:

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

Other important facts about the Blue Spruce:

- The largest Blue Spruce on record is 126' high and 15' 8” in circumference found in Colorado.

- The Blue Spruce can better endure moisture loss than the other trees found in our forest and is more resistant to harsh winters, 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' 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 effects the whole stand.

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

- The Blue Spruce provides food and shelter for many types of birds. Deer will often eat the foliage.

- The Blue Spruce is the state tree of Colorado.

Tree Tag

This simple game allows students to test their knowledge of tree species. To play, find an open meadow bordered by trees and have the trees be the boundary for the game. Announce that if they touch certain species of trees (which will be announced by the HT staff member) they will be "safe", but only if they are touching the right tree and that the "right" tree will change periodically. The counselors will be "it" and the judges, or a student may be chosen to be "it". Mix it up by announcing the characteristics of the trees. For example: "Find a tree that has a shallow root system and can be blown over in high winds." Students should then try to find 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 the 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 scratches heal easily enough; bigger injuries can bleed and leave bad scars. If too much skin or bark is destroyed, death can occur) 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 chlorophyll and release oxygen as a by-product. Also like people, trees may contract 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 ground or floor (against the trunk) with their legs facing outwards from the base of the trunk (put students close together if there is a large group, otherwise use 2-3 students and spread them out). The taproots add stability and suck up water that is vital to the tree's 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 while making a loud "slurping" sound.
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 traveling 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 hand in the air to make food and make a "whoooo" noise to emphasize the food being transported around the tree.

(The rest of the group forms the bark and fends off the creatures wanting to attack the tree while everyone else continues their actions and noises all at the same time.)

Tree Detectives

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

Lead the counselor led groups north to the tree grave yard located directly behind Sunday Rocks. Here the 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 conduction 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 world view).

Police Report: A Ponderosa Pine is currently under attack 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 its methods of spreading.

Note: Mistletoe is a brownish-orange, finger-like protuberance. It is a parasitic plant, growing where the tree bark has been 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 feet and spreads 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 the area Ponderosa Pines, leaving full branches stripped of bark. Who did it? How do you know? Determine the extent of the crime: Is it murder? Or will the victim survive?

Note: A tree with a large portion of its bark removed during certain seasons will literally bleed to death. Porcupines are one of the worst offenders, often killing trees by over-eating.

Police Report: A gang of dangerous thugs have been sneaking into trees and eating their cambium layer, cleverly leaving the bark 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? Who is trying to help? Find evidence of both activities. Will the crime-stopper's efforts end up killing the victim, or helping it?

Note: Bark beetles live under the bark of trees and eat the cambium layer. They are often helpful in the decomposition process in 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 trees without harming them.

Police Report: One tree in this area has undergone electric shock and survived. Another tree has not been so 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.

Note: If lightning does not completely burn a tree, it may 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 if it is losing sunlight. Then locate and identify the thief. Is a crime being committed here?

Note: Older Aspens begin to lose their lower branches as sunlight fails to reach these leaves. You can tell where these branches have been by the “black eyes” which line the Aspen's trunk. The death of the Aspen in the shade of firs or spruce is part of the forest's 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 often hurry this process along by selective cutting to help strengthen the forest.

On the way to the Tree-house...

Seed Dispersal

Have a bunch of old wool socks that 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 notices certain seeds sticking to his socks. The study of Biomimicry looks at how we as humans can borrow ideas from nature.

See what 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 to reproduce just a few, or even a single tree. Remind students that the average Douglas Fir will produce two million seeds in a single year---and that just here on the ranch there are thousands of Douglas Firs. Ask students: Do all the fir seeds eventually grow into trees?

Tree Reproduction Game

Here's how to play:

- All the students will represent Douglas Fir seeds.
- The counselors will be "it", representing squirrels, birds, insects and other animals that eat the seeds.
- The fir seeds that are carried by the wind can only run when it is announced that the wind is blowing.
- When a student is tagged (eaten), they must sit down.
- Other students continue to run around.
- Then announce that all fir seeds wearing red have just landed on cement. All fir seeds wearing green have just fallen into a swamp. (These students sit down.)
- Repeat several times that seeds have fallen in the shaded, poor soil of the forest or on a hot, south slope.
- When there are still a few seeds 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 Activity

Students will: Examine what factors contribute to the spread of a forest fire.
Approximate time: 20 minutes

Divide students into their HS-led groups. Each group receives forty matches and a rectangle of masonite, with screw to adjust the angle of the board with the ground. **Keep the matchbox away until you are ready to have the first group light their forest.**

Each group constructs their own forest. Assign some guidelines for each so that the forests are different - one will stay flat on the ground, one at a 20 degree angle, and one at 45 degrees. Have them strategize about how they want to place their matches - how much mitigation? One group might choose to model a part of the High Trails woods, the Black Forest, etc.
After each group has discussed and built their forest, light one match in each forest, one at a time.

It is important to keep this activity highly structured, with only one source of fire that you control. It is OK to let a student light a match as long as you are directly in control of the situation. Use jars of water that students may drop lit matches into when finished.

What natural and human factors might assist the growth of a wildfire?
What natural and human factors might arrest the progress of a wildfire?
When can wildfires be productive, even necessary for the health of a forest? When should a wildfire be stopped?

Wildfires, especially the idea that certain fires are natural and necessary, can be a sensitive topic for students who have had some personal experience with a wildfire that affected their home. Since the late 1890's, extended drought and increased development near wildlands have contributed to hundreds of large, severe fires and huge property losses.

Many ecosystems rely on a regular cycle of forest fires to clear out undergrowth and restore certain nutrients to the soil. Lodgepole pine cones require the extreme heat of a fire to burst open and germinate. Fires that remain on the forest floor do not do damage to trees such as Ponderosa Pines, which have a fire-resistant bark specifically for the purpose of surviving fires.

Wildfires that jump to the forest canopy can be far more dangerous and destructive. This happens when the forest has built up an undergrowth of *ladder fuels,* or small brush and debris that might be cleared out by regular, naturally occurring small fires. When we do not permit these small-scale fires to burn, we risk enormous fires that are less frequent but quickly grow out of control.

For a thoughtful group, it can be interesting to explore what should be done when people choose to settle in areas that have naturally occurring wildfire cycles.

Magic Forest

Students will:	1. Reflect and write in journals.
Approximate time:	**1**5 minutes

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

Sit under a tree and look up to see its arms reaching for the sky. Think about the roots underneath and how far the extend in all directions under the ground. **Ask students:** What would it be like to be rooted in one place for hundreds of years, not being able to get away from the thunder and lightning, icy blizzards, high winds, hail or rain? But remember the good times when the warm sunlight filters through the needles and it feels good to stretch and grow.

Something to think about: What about all the people the trees have seen in the past hundred years? They must have "seen" the Ute Indians, explorers, miners, trappers, ranchers, hunters, wood-cutters and even other students. They must have "seen" elk and deer, coyotes and porcupines, rabbits and bunnies in their burrows and the squirrels chasing each other through the neighborhood.

Have the students jot down in their journals a few ideas about the forest today. Have them create a poem, or an original thought, or maybe a story told by a certain tree, or an animal family who lives there. Have them add a sketch or drawing, write a song or just take some quiet time. Remind them that this is their time to sit and be a part of the life of the forest.

The 4-Story Tree House

Students will:	1. Climb 30 feet to the top of a stand of a Ponderosa Pine. 2. Review tree physiology concepts.
Approximate Time:	**20** minutes

The sight of the tree-house will generate tremendous excitement from the group, so it is a good idea to set some guidelines (see Safety Guidelines 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 of the fourth floor.

After the student have had some "fun time", assign each group (High School counselor included) to a level in the tree house. Instruct the students that each floor represents a part of the tree. The bottom floor represents the roots, the second floor represents the stem, the third floor represents the branches and the fourth floor represents 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 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 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 Guidelines:

It is a good idea to send two high school counselors ahead of the group to supervise the first and fourth floors. Basic ground rules for the tree-house should include: no rough-housing, one person on the ladder at a time, no throwing anything from the tree- house, and each floor should have an adult or high school 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 group and the forest ecologists and smokejumpers in the other group. Give the groups 5 minutes to come to a consensus on what position they will argue and then have them formulate a brief opening argument, complete with concise, concrete examples on why their position should be honored. Once the groups are ready to begin, decide which group will present first by flipping a coin or playing a game of rock-paper-scissors. After each group has delivered their opening arguments, the High Trails staff, acting as the debate moderator, will pick 2-3 points noted by both sides to offer for a counter debate in which both sides will be able to argue back and forth. The High Trails staff member should conclude the debate by summarizing each group's chief arguments and then encouraging a discussion geared towards reaching a compromise. **Ask the group:** *How can we remove some trees for essential human use, while maximizing the forest preservation for the purpose of maintaining wildlife protection and ecosystem preservation?* (carbon sequestration, O_2 production, soil stabilization, and water filtration)

Other suggested 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? What is the right way?

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

How can each of us help to protect the forests and the 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 debriefing 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 is 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 should line up at the border as the elk. The coyotes job is to hunt the elk. They do this by tagging the students as they run across the playing field using trees (backpacks and jackets) as safe zones. Elk should only run across on the leader or counselor's 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 should realize it is harder for the elk to make it safely across without the natural protection of the trees.

Woodsmen All-Day

Paper-making

Students will:	1. Make raw paper from pulp. 2. Discuss the use of renewable resources and importance of recycling.
Approximate 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. 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 waste products (otherwise burned or buried, which wastes land and causes air pollution) and turn 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 and boxed cereals, paper is never far from our reach. Global paper use increased more than six-fold over the latter half of the 20th century, and has doubled since the mid-1070's.

About 93% pf 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% of the municipal solid waste burden in many industrial countries.

Making the Paper

Paper is made by chopping up wood into chips, them 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.

Procedure for paper-making:

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

At the Sawmill

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

I. **Discussion:** *Why do we need to cut down trees?*
- *forest fire, burn areas, mitigation, beetles, healthy forest*
- *uses of trees*

II. **Felling the Tree** (if possible)
1. *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 did this tree begin? What was going on in history (US and World) when this tree began?*

(IMPORTANT TO DISCUSS SAFETY PRECAUTIONS AT THIS TIME)

I. **Sawmill –** History of the Sawmill, tour the mill, planer, and edger. Upon arrival at the sawmill, allow the students to 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, and buildings. 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. Have students investigate the pavilion and "rough cut" wood or other scraps around the sawmill.

Questions to ask: *What are uses for the boards?*
How many boards do you believe will we get out of a tree?
Look closely at the old blades. How do the teeth work? What if the blade 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 saw blade: *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 sharpener 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 if it continues the blade can break. If the blade becomes warped, it has to be hammered straight again by someone who knows how to do this, of which there are only 5-10 experts in the US that can. 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 cause misalignment and can cause problems for the miller running logs through the blade.

Inspect the motor, drive belts, and carriage.

At the Sawmill continued...

Have the students carry a log using the log carriers

Questions for Final Discussion:

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 them?

Fire Mitigation

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

Compared a mitigated forest (along Hercules) to a non-mitigated forest.

Why is one forest more healthy than the other?

How do forest fires burn?

Woodsmen Prescribed Thinning Activity

The 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 defects. The activity can be prefaced with a brief discussion on the preventative timber measures carried out by the U.S. Forest Service. (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 of the forest specialist and the marked timber is sold and 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 the 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 Douglas Fir.

Prescription #2: This is best conducted in an open area of large Ponderosa Pine.

Prescription #3: This necessitates an area of highly defected older growth---look for mistletoe, lightning scars, porcupine damage, gnarled branches, and over-shadowed but otherwise healthy young growth.

Give each counselor their thinning prescription and show them the area designated. Each group should also have a few feet of neon flagging to tie on "CUT" trees and a tape measure to take the circumference of the trees. Based on the prescription card and what they have learned, students decide which trees 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.
Approximate Time:	**20** minutes

Have the students look at the trees located in the immediate area.

Ask them: *How old do you think they are?*

Now have the students look at the trees that are ready to go into the sawmill (or take along the sets of preserved cross sections in the Woodmen box). Instruct the students to 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. Have them compare the size of the tree with the size of the trunk sample and approximate the age of the tree.

Ask them: *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 make 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 Identification: Tree Name and Picture

Slope Aspect: (North, South, East, West) How does slope effect LIGHT AVAILABILITY, SOIL MOISTURE and TEMPERATURE, and consequently TREE GROWTH or SPECIES COMPOSITION?

Soil Characteristics and Profile Sketch:
What factors effect soil composition, layers, moisture and 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: Evidence or scars or disease? Wide rings? Narrow rings? Competition? Cone Producing? (Estimate age, diameter and height)

Measuring Tree Height

Measuring the height of a tree is a fun, hands-on mathematics activity. A tree's height has many consequences for its neighboring trees, 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 take another estimate. Switch partners and see if there is a consistent estimate.

Loggers Estimate

Work with a partner. One person stands at a distance from the tree and extends their arms to full arm's length. Bracket the tree height between the thumb and fore-finger. 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's fore-finger. (It is important that the first student keep their arms fully extended throughout the activity.) The distance on the ground equals the height of the tree.

Shadow Estimate

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

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